SCIENTIFIC AMERICAN

[Entered at the Post Office of New York, N. Y., as Second Class matter. Copyrighted, 1891, by Munn & Co.

A WEEKLY JOURNAL OF PRACTICAL INFORMATION, ART, SCIENCE, MECHANICS, CHEMISTRY, AND MANUFACTURES.

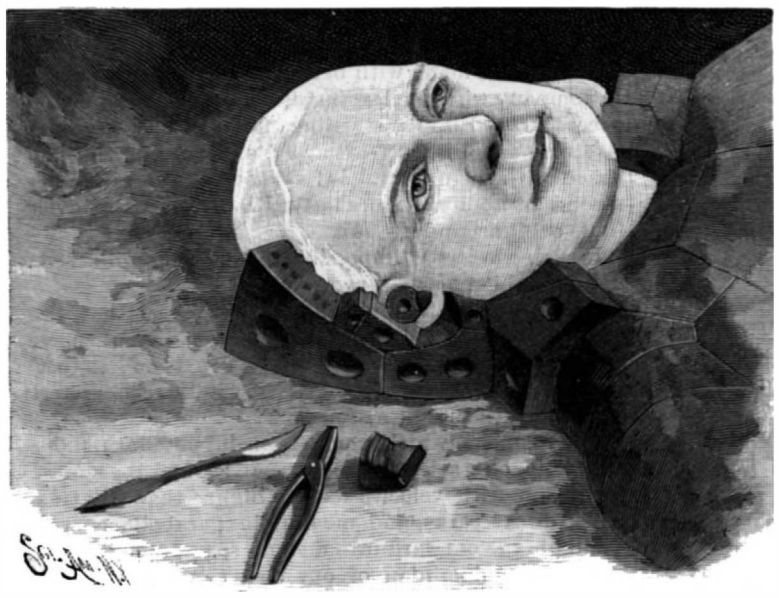
Vol. LXIV.—No. 26. ESTABLISHED 1845. NEW YORK, JUNE 27, 1891. [$3.00 A YEAR. WEEKLY.

CASTING THE HENRY WARD BEECHER STATUE FOR THE CITY OF BROOKLYN.

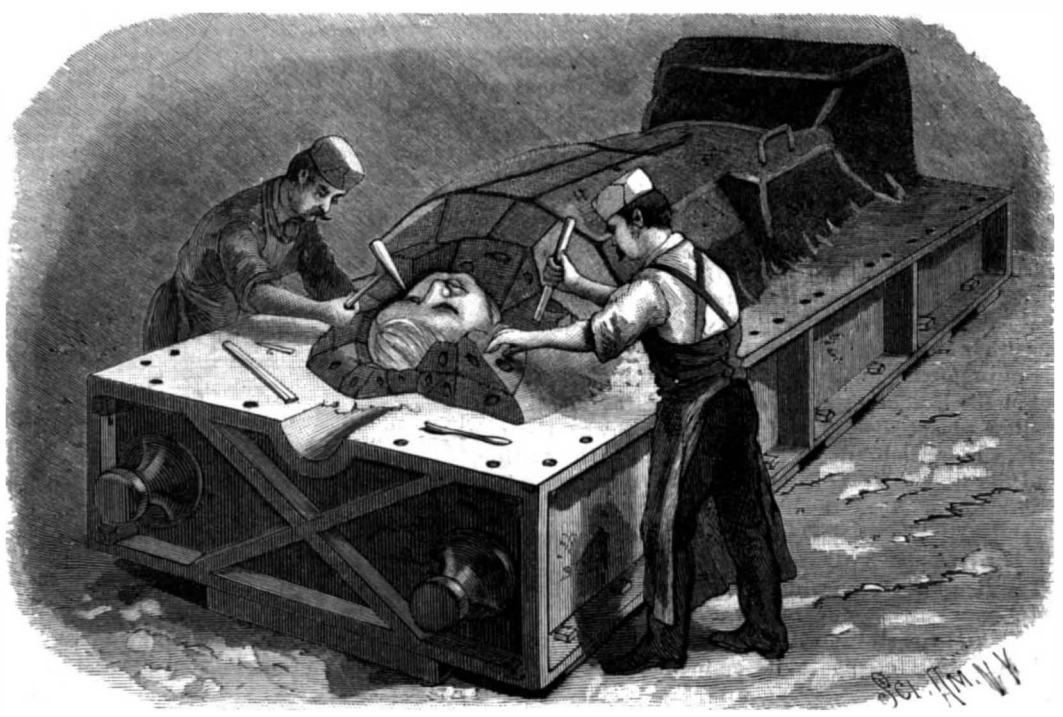
The Henry-Bonnard Bronze Company, of this city, have recently completed the casting of a statue of the late Henry Ward Beecher, to be erected in front of the Brooklyn City Hall. The statue is remarkable as being cast practically in a single piece, the head being of one piece with the body. Originally metallic statues were made in small pieces and were united by rivets or soldering. Some were cast solid. The present practice is to cast them hollow, and as thin as possible. This secures rapid cooling and tends to prevent any separation of the constituents of the alloy. It also economizes in metal.

The first step in making a statue is the production of the plaster model. This is supplied by the artist, and it comes from his studio of the exact size required for the final statue. The original studies in the case of colossal statues such as the present may be very small, but before the artist is done with his work, the full sized model is produced.

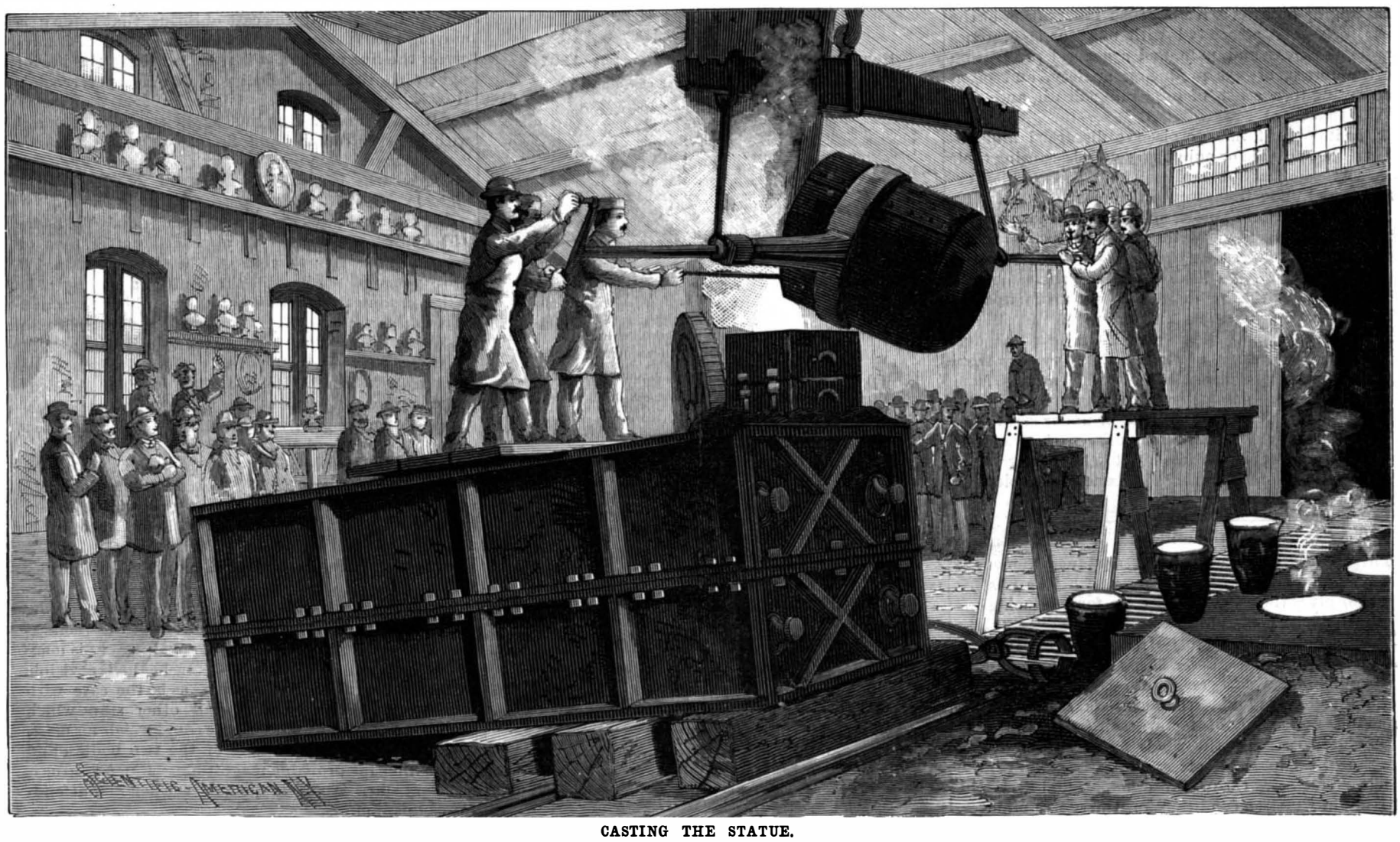
In the present case the statue was to be about nine feet high. The area of the flask in which the mould was to be made was seven feet four inches wide by thirteen feet six inches long. The model was established upon the lower section of the flask and the work of building up the mould began. The sand used is mined in France. It possesses to a high degree the property of consolidating, yet is very porous. A famous bed of the material is at Fontenay-aux-Roses, about 16 miles from Paris. This is compacted by wooden mallets and hand rammers of different shapes. As the artist produces his statue without any reference to its capacity for "drawing" from the mould, the bronze founder has to adapt his work to the most exacting conditions of undercutting and complicated outlines. The mould is therefore built up in very numerous sections, some of them extremely small. An exact count was not kept, but in the present statue between one thousand and fifteen hundred pieces were used in the mould. In one of the cuts, where the operation of moulding the head is shown, the idea of the subdivision of the mould appears. It will be seen that its sections represent irregularly shaped bricks, all fitting together with the utmost nicety and accuracy. The statue is eventually completely embedded in clay. The mould has now to be opened up, the edifice



MAKING THE MOULD.



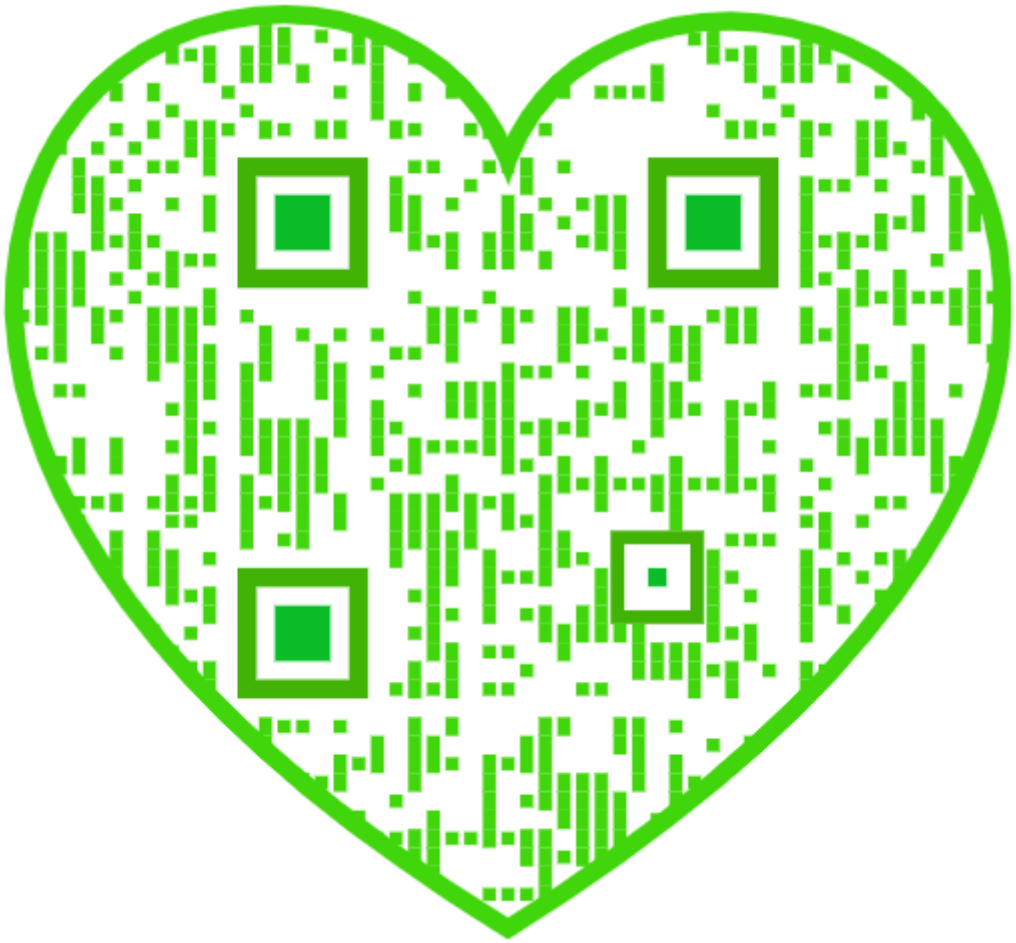
TAKING THE MOULD TO PIECES.



CASTING THE STATUE.

CASTING THE STATUE OF HENRY WARD BEECHER.

© 1891 SCIENTIFIC AMERICAN, INC.



of over a thousand sections is carefully taken down and the model is lifted from its resting place upon the lowest flask section. The mould is next rebuilt, the inner surface receiving a coating of foundry facing, and the interior is rammed full of clay to form the core. This core need not be solid. Some spaces may be left in it for the gases to collect in. Thus the mould is a second time complete and intact, but is filled with a clay figure instead of a plaster one.

The mould is a second time dismantled and the core is taken in hand. From its entire surface a layer of clay is removed, to average, as nearly as possible, one quarter of an inch in depth. This delicate operation provides the space for the metal to occupy in the casting process. This core thus reduced in size is replaced upon the flask and is properly supported. The mould is a second time built up, surrounding in this case the reduced core. A number of channels or gates are worked in the mould to allow the metal to run through to different parts of the figure. These resemble somewhat the trunk and branches of a tree. They start of comparatively large section near the pouring reservoir, and fork and diminish repeatedly, reaching the space between core and mould in many places. When all is perfectly dry, and the flask filled with sand so as to hold all the pieces in place, the operation of casting is proceeded with. In the present case seventeen weeks were required for the moulding.

The process of casting a bronze statue is executed either by surface or bottom casting. In the latter method a reservoir is arranged over the gates, which reservoir is large enough to hold all or a large portion of the metal. It has holes in its bottom corresponding exactly to the gates in the mould. These holes are plugged. The metal is poured into the reservoir, and by withdrawing the plugs the metal runs down into the space in the mould. The Beecher statue was cast by surface pouring. The metal held in crucibles was poured directly into the gates. This enabled a constant watch to be kept upon its fluidity and general nature as far as shown in its fusion. A man, as the metal was poured, kept scraping back all scoria, slag, and oxide from its surface. The adoption of one or the other system of pouring the metal rests, as a matter of preference, with the individual founder.

For the Beecher statue 7,400 pounds of metal were melted repeatedly. The fourth fusion was the one used. Eleven minutes were occupied in the casting, and the finished statue weighed 3,600 pounds. The rest of the metal represented the contents of the gates, waste, etc. The alloy was composed of copper 90 parts, tin 10 parts, zinc 3 parts.

The Beecher statue will be unveiled about the time this paper reaches our readers. The artist is J. Q. A. Ward, and the statue will, in the artistic and mechanical sense, be a credit to its eminent artist and to its founders.

Angina Pectoris—Its Nature.

Dr. R. Douglas Powell, in *The Practitioner*, argues that angina pectoris is a disturbed innervation of the heart or vessels, associated with more or less intense cardiac distress and pain, and a general prostration of the forces, always producing anxiety, and often amounting to a sense of impending death, and concludes that:

1. In its purer forms we observe disturbed innervation of the systemic or pulmonary vessels, causing their spasmodic contraction, and consequently a sudden extra demand upon the propelling power of the heart, violent palpitation or more or less cramp and paralysis ensuing, according to the reserve power and integrity of that organ—*angina pectoris vasomotoria.*

2. In other cases we have essentially the same mechanism but with the extra demand made upon a diseased heart—*angina pectoris gravior.*

3. The trouble may commence at the heart through irritation or excitation of the cardiac nerves, or from sudden accession of anæmia of cardiac muscle from coronary disease—*primary cardiac angina.*

4. In certain conditions of blood or under certain reflex excitations of the inhibitory nerves, always, however, with a degenerate feeble heart in the background, we may observe intermittence in its action prolonged to syncope—*syncopal angina.*

Artificial Gold.

There are a great many metallic substances known for producing metal closely resembling gold. The *Western Jeweller* gives the following formula for producing one of the artificial gold substances:

Take 100 parts (by weight) of pure copper, 14 parts zinc or tin, 6 parts magnesia, 56 parts sal ammoniac, 18 parts quicklime, 9 parts cream of tartar. Melt the copper, and add gradually the magnesia, sal ammoniac, quicklime and cream of tartar, each by itself, in the form of powder. Stir the whole for half an hour, add the zinc or tin in small pieces, and stir again till the whole is melted. Cover the crucible, and keep the mixture in a molten condition for thirty-five minutes. Remove the dross, and pour the metal into moulds. It has a fine grain, is malleable, and does not easily tarnish.

Scientific American.

ESTABLISHED 1845.

MUNN & CO., Editors and Proprietors.

PUBLISHED WEEKLY AT

No. 361 BROADWAY, NEW YORK.

O. D. MUNN. A. E. BEACH.

TERMS FOR THE SCIENTIFIC AMERICAN.

One copy, one year, for the U. S., Canada or Mexico.....$3 00
One copy, six months, for the U. S., Canada or Mexico..... 1 50
One copy, one year, to any foreign country belonging to Postal Union. 4 00

Remit by postal or express money order, or by bank draft or check.
MUNN & CO., 361 Broadway, corner of Franklin Street, New York.

The Scientific American Supplement.

is a distinct paper from the SCIENTIFIC AMERICAN. THE SUPPLEMENT is issued weekly. Every number contains 16 octavo pages, uniform in size with SCIENTIFIC AMERICAN. Terms of subscription for SUPPLEMENT, $5.00 a year, for the U. S., Canada or Mexico. $6.00 a year to foreign countries belonging to the Postal Union. Single copies, 10 cents. Sold by all newsdealers throughout the country. See prospectus, last page.

Combined Rates.—The SCIENTIFIC AMERICAN and SUPPLEMENT will be sent for one year, to any address in U. S., Canada or Mexico, on receipt of *seven dollars*. To foreign countries within Postal Union, *nine dollars a year.*

Building Edition.

THE ARCHITECTS AND BUILDERS EDITION OF THE SCIENTIFIC AMERICAN is a large and splendid illustrated periodical, issued monthly, containing floor plans, perspective views, and sheets of constructive details, pertaining to modern architecture. Each number is illustrated with beautiful plates, showing desirable dwellings, public buildings and architectural work in great variety. To builders and all who contemplate building this work is invaluable. Has the largest circulation of any architectural publication in the world.

Single copies 25 cents. By mail, to any part of the United States, Canada or Mexico, $2.50 a year. To foreign Postal Union countries, $3.00 a year. Combined rate for BUILDING EDITION with SCIENTIFIC AMERICAN, $5.00 a year; combined rate for BUILDING EDITION, SCIENTIFIC AMERICAN and SUPPLEMENT, $5.00 a year. To foreign countries, $11.50 a year.

Spanish Edition of the Scientific American.

LA AMERICA CIENTIFICA E INDUSTRIAL (Spanish trade edition of the SCIENTIFIC AMERICAN) is published monthly, uniform in size and typography with the SCIENTIFIC AMERICAN. Every number of *La America* is profusely illustrated. It is the finest scientific, industrial trade paper printed in the Spanish language. It circulates throughout Cuba, the West Indies, Mexico Central and South America, Spain and Spanish possessions—wherever the Spanish language is spoken. $3.00 a year, post paid to any part of the world. Single copies 25 cents. See prospectus.

MUNN & CO., Publishers,
361 Broadway, New York.

☞ The safest way to remit is by postal order, express money order, draft or bank check. Make all remittances payable to order of MUNN & CO.

☞ Readers are specially requested to notify the publishers in case of any failure, delay, or irregularity in receipt of papers.

NEW YORK, SATURDAY, JUNE 27, 1891.

Contents.

(Illustrated articles are marked with an asterisk.)

Agriculture, the chemistry of... 407
Angina pectoris..... 400
Annam, a visit in*..... 403
Arcturus..... 400
Assaying gold and silver*..... 404
Banana flour..... 401
Battle ship model, World's Fair* 405
Beecher, Henry Ward, casting statue of..... 399
Bicycle gear, Bigelow's*..... 403
Car brake, Marold's*..... 403
Coal beds in Pennsylvania..... 402
Copyright American..... 404
Diamonds, phosphorescence of.. 402
Electric motor, a toy*..... 403
Engine, Clark's*..... 403
Gold, artificial..... 400
Inventions recently patented.... 408
Inventions, room for..... 402
Lister, Cunliffe, inventor..... 406
Machinery Hall, World's Fair*.. 405
Notes and queries..... 409
Patents granted, weekly record of..... 409
Propellers, small, best..... 406
Phosphate beds in Southern States..... 407
Planets, position of, in July..... 401
Railroad tie, metallic, Smith's*.. 402
Rifle range, guards for a*..... 402
Snake, poisonous, of Florida..... 401
Statue, moulding and casting*... 399
Vines, trailing, forming figures*. 403
World's fair, Chicago*..... 405

TABLE OF CONTENTS OF

SCIENTIFIC AMERICAN SUPPLEMENT

No. 808.

For the Week Ending June 27, 1891.

Price 10 cents. For sale by all newsdealers

PAGE

I. CHEMISTRY.—A Simple and Rapid Method of Gravimetric Analysis.—By G. H. BAILEY.—An interesting and novel method of chemical analysis based upon specific gravity of precipitates, with tabulation of results and description of apparatus.—2 illustrations..... 12913

II. DRAWING.—The Spirograph.—Description of an instrument for drawing spirals, with samples of its work in pencil and ink.—2 illustrations..... 12905

III. GEOGRAPHY AND EXPLORATION.—Peary's Greenland Trip.—By R. E. PEARY, U.S.N.—Lieut. Peary's own account of his exploring party for the discovery of the northern terminus of Greenland, an elaborate description of the plan and prospects of the party and of their equipments.—Notes upon a second Arctic expedition for investigations upon the east coast of Greenland under Lieut. Ryder..... 12908

IV. GEOLOGY AND MINERALOGY.—Artificial Hornblende.—Formation of this mineral artificially.—A very curious example of synthetic mineralogy..... 12914
Kaolin Beds.—Notes on the newly opened kaolin beds of Blandford, Mass., with analysis of the kaolin found there..... 12914

V. MECHANICAL ENGINEERING.—Atkinson's Cycle Gas Engine.—An ingenious gas engine, so arranged that in one revolution of its crank the suction, compression, working, and exhaust strokes are all produced.—2 illustrations..... 12907
Swing Jib Countersink Drilling Machine.—A drilling machine with a capacity for ship plates, 5 x 16 feet in area, without moving the plate.—1 illustration..... 12908

VI. METEOROLOGY.—New Registering Barometer.—Radier's registering aneroid barometer. 2 illustrations..... 12906
The Statoscope.—Another aneroid barometer constructed by Richards Brothers, with descriptions of its application.—1 illustration..... 12906

VII. MISCELLANEOUS.—To Those who Neglect Shadows.—A series of curious shadow pictures, giving an interesting series of silhouettes.—1 illustration..... 12911

VIII. MEDICINE AND HYGIENE.—Malarial Remedies and their Geographical Extension.—By Prof. ANGELO CELLI.—The geographical distribution of malaria, and a review of its bacteriological status and the effect of this type of diseases upon the blood.... 12911

IX. PHARMACY.—An Examination in Pharmacy.—The London examination in pharmacy.—An interesting example of how druggists' examinations are conducted in England..... 12912

X. PHYSICS.—An Inexpensive Mercurial Air Pump.—By R. W. WOOD, JR.—Description of an air pump requiring comparatively simple parts.—1 illustration..... 12905

XI. TECHNOLOGY.—Floating Soaps.—Details of the process of making floating soaps, thereby disposing of trimmings from cocoanut oil soap..... 12904
Nomenclature or Vernacular in Brick Making.—By S. K. FLETCHER.—The language of brickmakers.—Peculiarities of the manufacturing terms in different parts of the country..... 12904
The Manufacture of Liquid Carbonic Acid Gas.—The manufacture of liquefied carbon dioxide, as conducted in Paris.—4 illustrations..... 12903

XII. TOPOGRAPHY.—Simple Method of Measuring Heights in Hasty Topographical Surveys.—The use of a simple piece of section paper for determining the height of distant objects.—An excellent suggestion for rough field work.—2 illustrations..... 12906

XIII. ZOOLOGY.—Animal Life on a Coral Reef.—A review of the fauna of the coral reefs and of the conditions of life in the neighborhood thereof..... 12909
The Breeds of Dogs.—A continuation of this interesting article, describing several kinds of toy dogs, with views of skulls and of different living specimens.—5 illustrations..... 12909

ARCTURUS.

This brilliant star in the constellation of Bootes, now visible nearly overhead in the evening hours, was the subject of a very interesting lecture by Mr. Wm. H. Knight, recently delivered before the Cincinnati Society of Natural History. We give herewith a few extracts from the paper, which will appear in full in our next week's issue of the SUPPLEMENT:

Within the last two or three years a new and surprising value has been given to the parallax of Arcturus by Dr. Elkin, the astronomer of Yale University. Previous to his work at Yale he had acquired a reputation for painstaking observations and accurate results in the British observatory at the Cape of Good Hope. Equipped with a 7" heliometer provided with the latest improvements, he set himself the task of measuring the parallax of several prominent stars. Devoting himself specially to Arcturus, from no less than 89 observations, taken in connection with 10 comparison stars, he deduced the very small parallax of $\frac{1}{1000}$ or about $\frac{1}{56}$ of a second of arc, which is equivalent to a distance of 181 light years. This minute parallax (which is assumed to be approximately correct by other astronomers), combined with its large proper motion, gives Arcturus the tremendous velocity of 381 miles per second—a distance 40 miles greater than that which separates Cincinnati from St. Louis. Imagine a body moving from this city to the Mississippi River between the ticks of a clock.

Now, Dr. Elkin admits that there is what is technically called a "probable error" in his observations, but that error is + or —, and would be as liable to make the value of the parallax less than the figure named as to make it more. So that while the velocity of Arcturus *may* be 50 or even 100 miles less per second than computed, it may *possibly* be 50 or 100 miles more.

But until we get new data, based on more extended observations, made with better instruments, we may, in company with the leading astronomers of the world, accept Dr. Elkin's startling figures, and consider Arcturus as 181 light years away, and rushing through space with the unparalleled velocity of 381 miles per second, or about 21 times faster than the earth travels in its orbit around the sun.

Is such a velocity impossible? Is it incredible? Is unreasonable?

It has been mathematically demonstrated that the velocity with which matter, drawn from distant space, would fall upon the surface of the sun is no less than 383 miles per second, a velocity, it will be seen, almost identical with that of Arcturus.

Many comets which come from interstellar regions and visit our solar system sweep around the sun at perihelion with velocities even higher than that ascribed to Arcturus, and, moving in parabolic curves, again plunge outward into distant space, and passing beyond the dominion of our own sun, enter that of some other mighty star.

Thus far I have been considering the velocity of Arcturus *perpendicular* to or *across* the line of sight. But we have seen in the case of Sirius, that while it is moving with the comparatively low speed of 9 miles *across* the line of sight, it is receding *along* the line of sight with the high velocity of 20 miles per second. How is it with Arcturus? Is he approaching or receding from us? Mr. Huggins again comes to our aid with his spectroscope, and finds that, while Sirius is moving *away* from us at the rate of 20 miles per second, Arcturus is rushing down *upon* us with the far higher velocity of 55 miles per second.

But we need have no fear of a collision. While he will doubtless continue to approach us for tens of thousands of years to come, till he arrives within 140 light years or so, he will then, after a computable period gradually and then rapidly recede from us and from our part of the sidereal universe, and pursuing an unswerving course, with unabated velocity, he will, in a few million years, pass entirely out of the ken of the most powerful earthly telescope. For, while Arcturus is now approaching us at the rate of 55 miles per second, he is moving athwart our line of vision 381 miles in the same moment of time.

But *part* of that apparent motion of approach on the part of Arcturus is caused by the movement of our *own* sun, which, with its train of attendant worlds, swinging along through space at the estimated rate of 15 miles per second. Its course is directed toward the constellation Hercules, between Acturus and the Milky Way.

And now, having obtained some idea, however crude, of the great distance and rapid motions of this remarkable star, we are curious to learn something of his magnitude and physical structure. If he had a visible companion circling around him, as is the case with Sirius, Alpha Centauri, and some other stars which exhibit a measurable parallax, we could weigh his mass, or rather the combined mass of the two bodies, and thence infer his probable magnitude. But Arcturus is a solitary star. No telescope has revealed any attendant companion.

Our only resource, then, is to compare his light-giving power with that of other luminous bodies, and accept such conclusion as may be fairly drawn.

© 1891 SCIENTIFIC AMERICAN, INC.

There are three well defined classes of stars, judged by the quality of light they yield. In the first class are the clear white and bluish white stars like Sirius and Vega. These are supposed to be the hottest stars and the most luminous in proportion to the extent of their surface. Then there are the golden yellow or pale orange stars, of which Arcturus and Capella are fine examples. These have begun to cool. Finally, we have the deep orange and red stars like Aldebaran and Antares. These have advanced still further in the cooling processs.

Now the spectroscope informs us that our sun belongs to the orange or Arcturus type, and if we could view it from distant space, we should see a lovely star of a pale golden yellow. The question arises, then, how far would our sun have to be removed in order to shine with a brightness no greater than that of Arcturus? According to Mr. Maunder, it would have to be removed to 140,000 times its present distance, or about half the distance between us and Alpha Centauri.

But Arcturus is 11½ million times as far away as the sun, and if our sun were placed at that enormous distance, its diameter would have to be 82 times as great in order to give a light equal to that received from Arcturus. I hesitate to present such figures, implying magnitudes far beyond any to which we have been accustomed, yet they are but the logical deductions of observed facts. In other words, upon Mr. Maunder's reasonable assumption, Arcturus must be a gigantic sphere, 550,000 times larger than our sun, with a diameter of seventy million miles, or more than large enough to fill the entire orbit of Mercury.

To make this contrast clearer, let us institute a simple comparison. Jupiter is larger than all the other planets and satellites of the solar system. The sun is a little more than 1,000 times larger than Jupiter. But Arcturus, if our inference is correct, is 550,000 times larger than the sun. By the side of such a majestic orb, our sun, grand and overwhelming as he is in our *own* system, would dwindle to an insignificant star.

Contemplating a world so vast, endowed with such mighty energies, and rushing with such resistless force through the great deeps of space, we cannot resist the questions: Whence came this blazing world? Whither is it bound? What is its mission and destiny? Is it simply a visitor to our sidereal galaxy, rushing furiously through it like a comet? Is it being constantly fed and enlarged by the worlds it encounters and the meteoric matter it gathers up in its wonderful journey? What would be the effect if it chanced to pass through a nebula or a star cluster? Was the new star which suddenly blazed forth in the nebula of Andromeda in 1876 due to a similar cause?

As this mighty aggregation of attractive energies sweeps along his celestial path, thickly bordered with stellar worlds, how many of those worlds will yield forever to his disturbing forces? How many will be swerved from their appointed courses by his irresistible power? How many will plunge into his fiery bosom and be swallowed up as a pebble is swallowed by the ocean?

Are there many great suns like Arcturus, flying on their special missions through space? The late Dr. Croll, in his work on "Stellar Evolution," published two years ago, conjectures that the original constituent bodies of the universe were endowed *ab initio* with high velocities, and that in their swift journeys through space each eventually comes into collision with one of his fellows.

The terrific impact of two bodies moving with a velocity of tens and even hundreds of miles per second transforms the energy of motion into heat, and both worlds are shattered into fragments, melted as in a furnace, and dissipated into luminous gas. And thus a nebula is formed which fills vast regions of space and is ultimately, in the lapse of untold ages, evolved into new systems of worlds.

Sublime as is our theme—a universe of mighty worlds, wonderful as is the complexity of their motions and influences, mysterious as is that power which pervades and rules the whole, more sublime, more wonderful, more mysterious is the human mind, which, from the standpoint of this little world, a mere speck in the great domain of creation, reaches out to the utmost bounds of the universe, formulates its laws, reconstructs its past, forecasts its future, and dauntlessly grapples with the varied problems of atoms and stars, matter and force, time and space, eternity and infinity.

The New Smithsonian Astro-Physical Observatory.

We learn from Dr. S. P. Langley, secretary, that there has been established as a department of the Smithsonian Institution a Physical Observatory, which has been furnished with specially designed apparatus for the prosecution of investigations in radiant energy and other departments of telluric and astro-physics. The communication of new memoirs bearing in any way on such researches is requested, and for them it is hoped that proper return can be made in due time.

POSITION OF THE PLANETS IN JULY.

MARS

is evening star until the 30th, and then morning star. He comes to the front on the July annals, for an important epoch in his course occurs during the month. He is in conjunction with the sun on the 30th, at 2 h. 41 m. A. M., being so near the sun as to be hidden in his rays, and also at his greatest distance from the earth. He passes at that time from the eastern to the western side of the sun and commences his course as morning star, slowly increasing in size and slowly approaching the earth, until his career as morning star culminates in the long anticipated opposition of August 4, 1892. Our ruddy neighbor is then nearer than he has been for fifteen years, or than he will be again for seventeen years. Months must pass before Mars becomes visible, but his movement though slow is sure, and the time is none too long to make a study of this interesting planet, the only member of the solar family whose real surface is revealed by the telescope.

The right ascension of Mars on the 1st is 7 h. 20 m., his declination is 23° 15′ north, his diameter is 3″.8, and he is in the constellation Gemini.

Mars sets on the 1st at 8 h. 5 m. P. M. On the 31st he sets at 7 h. 13 m.

MERCURY

is morning star until the 7th, and then evening star. He is in superior conjunction with the sun on the 7th, at 1 h. 18 m. A. M., when the smallest member of the solar brotherhood passes from the western to the eastern side of the sun and commences to oscillate eastward from the sun, in obedience to the law that regulates the movements of the inferior or inner planets. He meets Mars on the way, and the planets are in conjunction on the 11th, at 7 h. P. M., Mercury being 41′ north.

The right ascension of Mercury on the 1st is 6 h. 22 m., his declination is 24° 10′ north, his diameter is 5″.2, and he is in the constellation Gemini.

Mercury rises on the 1st at 4 h. 5 m. A. M. On the 31st he sets at 8 h. 13 m. P. M.

JUPITER

is morning star. He is by far the most distinguished member of the brotherhood on the July list. He passes no important epochs in his course, and he has no meetings or partings with other planets on the celestial road. He is simply a superb star, increasing in size, and rising earlier every evening, at 10 o'clock on the middle of the month and at 9 o'clock when the month closes. Observers who command a view of the southeast horizon should watch for the appearance of this regal planet, as he looms suddenly above the horizon, like a young moon, and shines the brightest of the radiant throng that cluster in the nightly sky.

The moon is in conjunction with Jupiter three days after the full on the 24th, at 2 h. P. M., being 3° 56′ south.

The right ascension of Jupiter on the 1st is 23 h. 18 m., his declination is 5° 53′ south, his diameter is 41″.6, and he is in the constellation Aquarius.

Jupiter rises on the 1st at 10 h. 54 m. P. M. On the 31st he rises at 8 h. 55 m. P. M.

VENUS

is morning star. The movements and position of Venus are in striking contrast with those of Jupiter. She is approaching and he is receding from the sun. She is nearly at her greatest, and he is nearly at his least distance from the earth. She is nearly at the minimum of her size and brilliancy, while he is approaching the culmination of his radiant career. Venus will be greatly missed in the summer evening sky.

The moon makes a close conjunction with Venus on the 4th, the day before her change, at 6 h. 2 m. A. M., being 2° 7′ north.

The right ascension of Venus on the 1st is 5 h. 14 m., her declination is 22° 20′ north, her diameter is 11″.0, and she is in the constellation Taurus.

Venus rises on the 1st at 3 h. 4 m. A. M. On the 31st she rises at 3 h. 49 m. A. M.

SATURN

is evening star. He is on the meridian on the 1st at 4 h. 20 m. P. M., so that he is well advanced on his western way when it is dark enough for him to be visible. He retains his position in regard to Jupiter, being nearly opposite to him, one planet setting as the other rises. The difference is seven minutes on the first of the month, and there is no difference on the last day of the month.

The moon is in conjunction with Saturn when five days old, on the 10th, at 4 h. 31 m. P. M., being 3° 25′ north.

The right ascension of Saturn on the 1st is 10 h. 58 m., his declination is 8° 44′ north, his diameter is 15″.8, and he is in the constellation Leo.

Saturn sets on the 1st at 10 h. 47 m. P. M. On the 31st he sets at 8 h. 55 m. P. M.

URANUS

is evening star. He is in quadrature with the sun on the 20th, at 5 h. A. M., being 90° east.

The right ascension of Uranus on the 1st is 13 h. 42 m., his declination is 10° 1′ south, his diameter is 3″.6, and he is in the constellation Virgo.

Uranus sets on the 1st at 0 h. 25 m. A. M. On the 31st he sets at 10 h. 28 m. P. M.

NEPTUNE

is morning star. His right ascension on the 1st is 4 h. 25 m., his declination is 20° 4′ north, his diameter is 2″.6, and he is in the constellation Taurus.

Neptune rises on the 1st at 2 h. 26 m. A. M. On the 31st he rises at 0 h. 31 m. A. M.

Mars, Mercury, Saturn, and Uranus are evening stars at the close of the month. Venus, Jupiter and Neptune are morning stars.

THE POISONOUS SNAKE OF FLORIDA.

A workman at Oakland, Orange Co., Florida, recently died from the effects of a bite received from a supposed harmless snake. The man had captured a small snake and handled it for ten or fifteen minutes, during which time he received a bite on one hand, giving him no pain at the time. Finally killing the snake, the man returned to his work.

About half an hour later pains came on in his hand and arm, followed by drowsiness and a dull pain in the head. The man quit work, saying he would lie down, and probably be at work again in a short time. He continued to feel drowsy, and a fullness of the eyelids, with a partial loss of control of muscular action of the same, was noticed.

At this point a doctor was called, who did all he could to counteract the effects of the poison, but his every effort proved unsuccessful, and the unfortunate man finally died eighteen hours after receiving the bite.

The snake was called a harmless garter or king snake. It was small and its body was circled with bright-colored bands. But an examination of its mouth disclosed two small fangs in the upper jaw. Our informant says: "Thus it seems this bright-colored, sluggish, meek little snake that we have regarded as harmless as a tadpole is one of the most dangerous of our reptile foes."

From the description received, and a residence of over twelve years in Florida, during which time I devoted much attention to herpetology, I can state positively that the snake in question was the coral snake, *Elaps distans*, also called the "Florida harlequin snake."

Its habitat is the Gulf States and Mexico. It is different from all other North American poisonous snakes in that it has not a well-defined neck, and that its tail tapers to a fine point. All other poisonous snakes in this country have large angular heads and blunt tails. The coral snake also lacks the "poison pit" of the rattlesnake, moccasin, and copperhead—a small orifice about midway between the eye and nostril on either side. This "pit" is connected with the poison sac, but its use has never been satisfactorily explained. As in the case of the coral snake, all poisonous snakes do not have the "pit," but every snake possessing it is armed with deadly fangs.

The color of the coral snake is varied with bright bands of black, white or yellowish white, and coppery red. It is rarely over eighteen inches in length (usually much less), and one-half or three-fourths of an inch in diameter. It is not common in Florida or the Gulf States.

There is another quite common snake in Florida which very closely resembles the coral snake, both in color and size. It is marked with brilliant bands of red, yellow, and black. It is called a garter snake, band snake, etc., by the natives, and by some it is thought to be poisonous. It is entirely harmless, however, and without fangs, as repeated examinations by myself and others clearly proved.

S. Weir Mitchell, in an article on "The Poison of Serpents," appearing in the *Century Magazine* of August, 1889, incidentally refers to the coral snake as "the beautiful coral snake, the little *Elaps* of Florida, too small with us to be dangerous to man."

That it *is* dangerous, under certain circumstances, the above instance—one of two or three cases known in which the coral snake of the United States has destroyed human life— proves beyond dispute. Owing to its scarcity, however, it is seldom met with, and its small size prevents it from inflicting a wound after the usual manner, but if one exposes bare feet and ankles or hands within striking distance, especially after irritating it, a hypodermatic injection of its venom is quite apt to be received, and is as much to be dreaded as a bite from the rattlesnake. CHARLES H. COE.

Banana Flour.

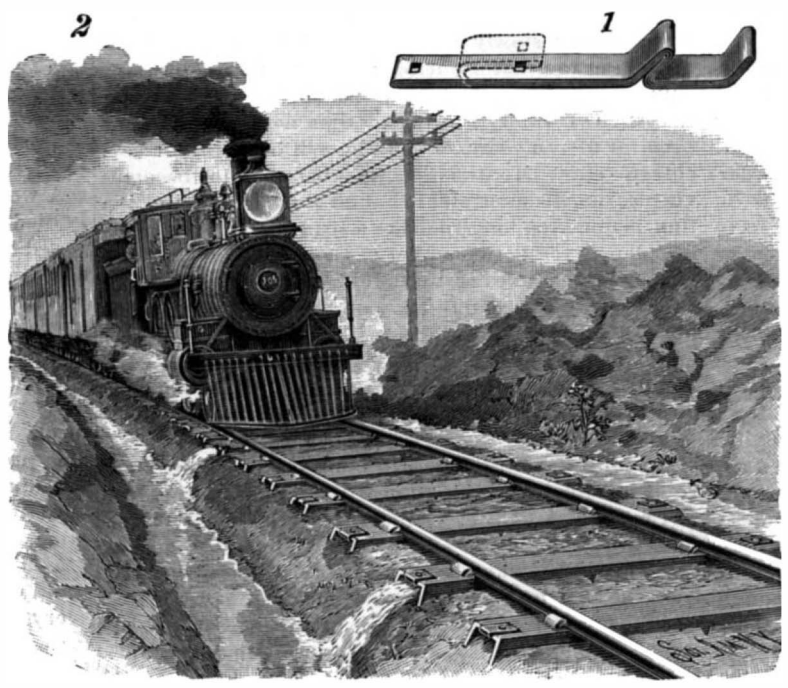
Referring to an article in the SCIENTIFIC AMERICAN of June 6, a correspondent says: The flour is made from green bananas—not ripe ones. They are peeled, sliced, and sundried, afterward pounded in a mortar and passed through a coarse sieve.

To preserve the ripe bananas they are dipped in lye and dried in the sun, shriveling up under this operation, and tasting somewhat like figs. The color of the banana flour is dirty gray, like ashes.

© 1891 SCIENTIFIC AMERICAN, INC.

A METALLIC TIE AND RAIL FASTENING.

The illustration represents the use of a hollow metal tie, designed to be self-ballasted, or form a gutter for the escape of water when desired, and also a rail fastening for employment therewith, the construction being simple and cheap, and the tie possessing a necessary amount of elasticity. The tie and fastening form the subject of two patents issued to Mr. Bridges Smith, of Macon, Ga. The tie is formed from a sheet metal blank, bent down at right angles on its parallel sides, and cut inward diagonally at its lower edges to form points for anchoring the tie in place, a portion also being bent inward horizontally between the points, thus forming a mainly rectangular body. When the hollow tie thus formed is put in place, it may be filled with earth, clay, or other suitable ballast, or, if laid where water is liable to seek a passage across the railroad bed, the filling is omitted and a plate is inserted adapted to cover the bottom of the hollow space of the tie, which is thus made to serve as a passageway for the water. To fasten the rail to the tie, a flat plate of malleable metal is employed, bent at one end to form two flanges, as shown in Fig. 1. These flanges are passed upward through slots formed for the purpose in the upper surface of the tie, one of the flanges being adapted to rest upon the top of the rail base at one side, while the other flange is bent backward to clasp the rail base on its other side. The outer end of the fastening plate is also doubled over to lie flat upon the top of the tie, to which it is firmly secured by a bolt passed through the tie and two sections of the plate, the bolt hole in the tie having a slightly elongated form to allow for the expansion and contraction of the fastening plate.



SMITH'S RAILROAD TIE AND RAIL FASTENING.

Mines and Mining—Bituminous Coal in Pennsylvania.

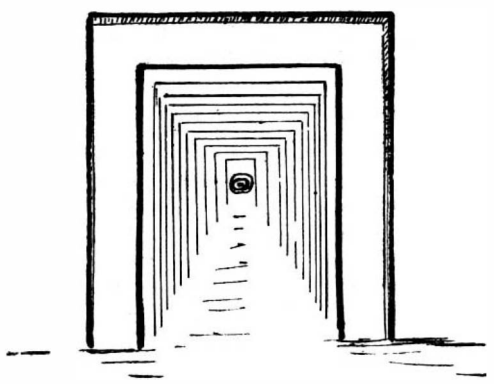
Mr. Robert P. Porter, Superintendent of Census, states in Census Bulletin No. 67, relating to bituminous coal in the State of Pennsylvania, which was prepared by Mr. John H. Jones, special agent, under the supervision of Dr. David T. Day, special agent in charge of the Division of Mines and Mining of the Census Office, that the output of the bituminous regions in the State was 36,174,089 short tons in 1889. The total value of the output is given as $27,953,215, or an average of 77·2 cents per short ton at the mines. The average number of persons employed in 1889 was 53,780, the amount paid for wages being $21,142,051. The output of small local banks and farmers' diggings is reported at 820,197 short tons. No report of this product has heretofore been attempted. The collection of this data was intrusted to resident special agents familiar with the territory under their charge, and the product of this important element of the coal industry in Pennsylvania is authentically given. The quantity sold to the local trade and to employes by regular establishments, together with this neighborhood mining, amounts to 1,590,651 short tons, or 4·40 per cent of the entire production. The amount of coal manufactured into coke during the year 1889 was 10,190,588 short tons, or 28·17 per cent of the total production. Altogether, the report shows a remarkable increase in the bituminous operations throughout the State.

The bituminous coal deposits of Pennsylvania form the northern extremity of the great Appalachian coal fields, and to a greater or less extent underlie all the territory of the State lying west of the crest of the Allegheny Mountains. The counties of Bradford, Tioga, Potter, Warren, Crawford, Venango, Forest, Elk, Cameron, Clinton, and Lycoming, in the northern portion of the State, exhibit only detached basins of the lower measures, which, however, are extensively mined, and the product finds ready markets for manufacturing purposes and for steam. The remaining counties, bounded by the western and southern State lines and a line drawn northward along the eastern boundaries of Fulton, Huntingdon, and Center counties, thence westwardly along the northern boundaries of Clearfield, Jefferson, Clarion, and Mercer, embrace an almost unbroken area of one or more of the important beds belonging to the carboniferous measures.

The counties of Allegheny, Westmoreland, Washington, Greene, and Fayette, situated in the southwestern corner of the State, contain the upper productive measures, at the bottom of which lies the notable Pittsburg bed, yielding in the vicinity of Pittsburg a gas coal of the highest quality; to the eastward the coking coals from which the celebrated Connellsville coke is made, and to the southward the Cumberland steam coals of Maryland. Small areas of this bed also occur in Indiana, Somerset, and Beaver counties. The remaining counties referred to contain only the lower productive measures, ranging from the isolated areas of the Pittsburg bed to the Brookville bed, the lowest in the lower productive series, and the Mercer, Quakertown, and Sharon beds in the conglomerate series. The product from this territory, as well as that from the southwestern counties wherever the lower measures are being mined, is classed in the trade as semi-bituminous, containing, as it does, less than 18 per cent of volatile combustible matter. While an excellent quality of coke is produced from coals mined in some localities from these lower measures, the distinctive advantages consist in their superiority as steam and rolling mill fuels, being much sought after for locomotive and steamship uses. In the Freeport and Kittanning beds of the lower productive series, cannel coal of good quality has been found to overlie the seam for considerable areas in certain localities, but on account of the veins being thin and troublesome to separate in mining it is not deemed of much commercial value.

RIFLE RANGE.

Target practice is a *sine qua non* where a regiment of soldiers, volunteer or regular, is to be efficiently maintained or worked into serviceable condition; and the possibility of keeping up, or starting, a good shooting range is at present, in many places, a source of much consideration and thought, the dilemma that some localities find themselves in being aggravated in an enlarged proportion as the population multiplies and the land increases in value in that locality.



Rifle practice is a source of much pleasure and healthful recreation, also creating a spirit of rivalry and emulation among the various members of a corps to such an extent that degrees of perfection are reached that would not otherwise be obtained. It also stimulates the young men, especially, to take an interest in the other duties devolving on a volunteer that, under other circumstances, would become tedious and irksome, but which are necessary to the successful and proper development of a well drilled and disciplined soldier.

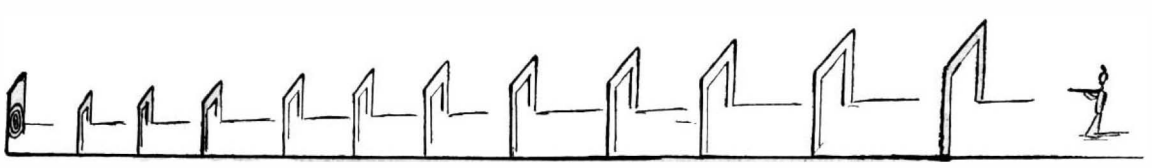
There are many places that have sufficient space within their garrison inclosure for short ranges, and others that have in their immediate locality large commons of sufficient area for all distance shooting. The rifle is, however, such a formidable weapon, and the regular as well as the volunteer service supply so many of the *raw recruit* class that the unwary traveler jeopardizes his life and limb should he find it necessary to pass within a radius of some hundreds of yards of the shooter on practice day. The direction of the butt of the rifle could, doubtless, be excepted, and considered a safe course in which to steer during even the novitiate of the future veteran of the musket.

The accompanying diagram illustrates a method of adapting a limited space to a serviceable and safe shooting range.

As the range need not in any respect be different from those at present in use, the bullet guards only require explanation. The guards should be of sheet iron, or other bullet proof substance, and so arranged as to present a broad surface all around the target, when looking toward the latter from the firing point, as represented in the small figure. The width of the surface of the guards would depend on the distance they are placed apart. Standing at the shooting box the full outline of the target is seen, but no open space, the surrounding iron of the target overlapping all open space not covered by the guards in front, so that, after passing through all the guards in its course to the target, the bullet, no matter how badly directed, could not get over nor on either side of the target to the open country beyond. In like manner, should the bullet take an eccentric direction, after passing all guards but the last, that one would save it from traveling into space, and similarly back to the first guard, which would stay the bullet of the most erratic marksman on the ground.

The widths and heights of the guards would have to be made to suit the range. Their distance apart would allow of wider or narrower surface, and the length of range would affect the height to allow of altitude of bullet in its proper course. A flange on the outer edge of each guard is desirable.

Toronto, May 19, 1891. A. C. PAULL.



A NOVEL FORM OF GUARDS FOR RIFLE RANGES.

The Phosphorescence of Diamonds.

In the New York *Sun*, Mr. G. F. Kunz, the well known expert in gems, has recently called attention to a property of the diamond which may serve as a means of distinguishing it from other substances. Referring to the paper of Robert Boyle "On a Remarkable Diamond that Shines in the Dark," published in the Transactions of the Royal Society in 1663, Mr. Kunz remarks that this paper has been indirectly alluded to by a number of authors, but never read. Among a quantity of facts Boyle mentions one diamond that phosphoresced simply by the heat of the hand, absorbed light by being held near a candle, and emitted light on being rubbed. He stated that many diamonds emitted light by being rubbed in the dark. The experiments made by Mr. Kunz show conclusively not only that Boyle's statement that some diamonds phosphoresce in the dark after exposure to the sunlight or an arc of electric light is true, but also that all diamonds emit light by rubbing them on wood, cloth, or metal, a property which will probably prove of great value in distinguishing between the diamond and other hard stones, as well as paste, none of which exhibit this phenomenon, and will be welcomed by the general public who do not possess the experience of the dealer in diamonds. The property is evidently not electric, or it would not be visible on being rubbed on metal.

Yet Room for Inventions.

Of all the sack-tying devices, none has proved of practical utility to the extent, at least, of supplanting the old fashioned way of tying with a string. A good sack tie would take wonderfully.

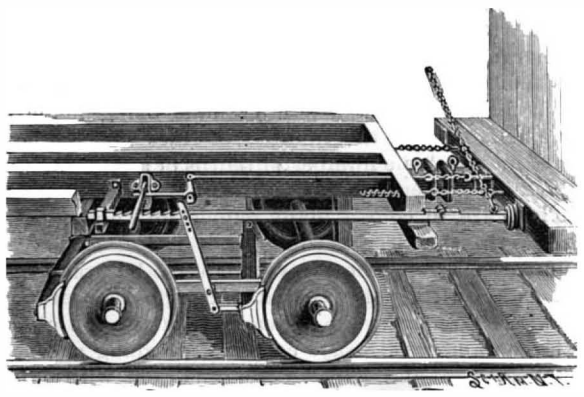
The man who invents a slow-moving feeding device for roller mills that will feed any sort of material, coarse or fine, heavy or light, will have a fortune. Of course it is claimed that there are several on the market, but there are not. Saying nothing disparaging of the many excellent machines for the purpose, they either do not do the work on soft stuff or else they run so fast that they are defective as to long life in good condition. The inventor can get up a slow-moving, perfect feed-regulating machine will have a fortune.

In building a mill it is the case too often that not enough attention is given to the height according to the breadth. This is sure to result in too many elevations and too many choking spouts. All of which means a hard mill to run, a mill that reduces stock, improperly, by elevator and conveyor friction, and a fuel consumer to no advantageous purpose.—*The St. Louis Miller.*

© 1891 SCIENTIFIC AMERICAN, INC.

AN IMPROVED CAR BRAKE.

The illustration represents a brake attachment designed to apply the brakes when the cars of a train are brought together and made to engage one with the other, releasing them when the train moves forward



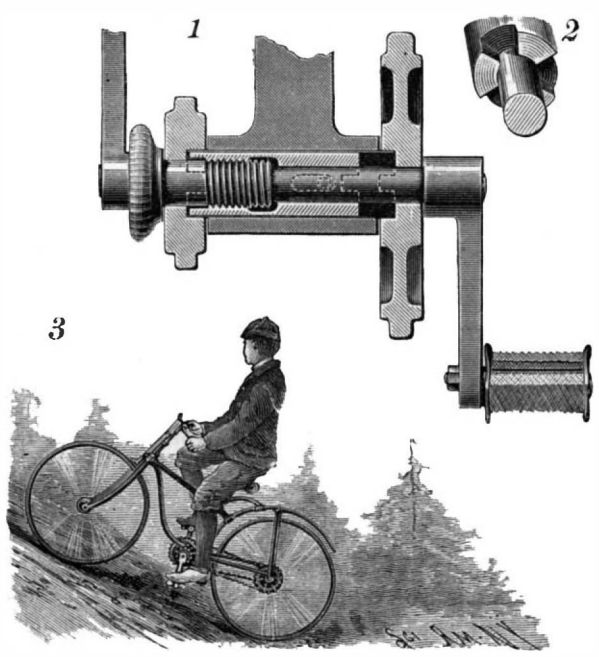
MAROLD'S CAR BRAKE.

or the cars are moved apart. It has been patented by Mr. John Marold, of New Decatur, Ala. At one side of the drawhead, and extending further outward, is a rack bar adapted to slide in the frout sill and on a rear guide beam, the outer end of the bar consisting of a hinged section which may be lifted out of horizontal position when desired. The outer end of the hinged section has a flat head adapted to engage a wear plate of an opposed car, and the bar near its inner end has a series of teeth engaged by a dog pivoted at one end to one of the beams of the car bed, the dog being also connected with a lever fulcrumed on one of the beams, and connected to a rod which extends through an aperture in the front beam of the car, where it is attached to a length of chain connecting it by a hook with the sill of an opposing car. The rack bar is connected with a lever fulcrumed upon a beam of the truck, the lever being connected with the brake beams, and both the rack bar and the lever have a series of holes through which their connection is effected by a registering bolt, for the purpose of regulating the degree of tension to be exerted upon the brakes through the movement of the rack bar. When it is desired to apply the brakes, the coming together of the ends of the cars, pushing the rack bar inward, causes the lever connected with the latter to put on the brakes, which are held thus applied by the engagement of the dog with the rack bar until the cars are moved apart, when the dog is moved out of engagement by means of the rod and chain connecting it with the opposing car, and the release of the brakes is thus effected.

When the cars are to be shunted or backed, the hinged outer end of the rack bar is drawn up and held out of horizontal position by means of a short chain. As a provision against the breaking of the coupling pin, bolts are arranged to slide in the sills at each side of the drawhead, and each having a bearing against a spring cushion, the bolts of one car being connected by chains with corresponding bolts on another car. The chains are of sufficient length to slightly sag when the cars are coupled in the usual way.

A DIFFERENTIAL GEAR FOR BICYCLES.

A construction by means of which a bicycle gear may be quickly changed, so that the vehicle may be driven rapidly where the road is easy, or less speed with more power may be had where the road is loose or hilly, is shown in the accompanying illustration, and



BIGELOW'S BICYCLE.

forms the subject of a patent issued to Mr. Frank R. Bigelow, of Gloucester City, N. J. Fig. 1 shows the device in section applied to the treadle shaft of a bicycle, the bearing of the shaft being supported by an arm in the usual manner. Mounted loosely on opposite ends of the shaft are different-sized sprocket wheels, each having on its inner side a series of sockets adapted to receive the teeth of a sleeve sliding on the shaft, the sleeve being of the length of the hub. Near the center of the sleeve, as shown in dotted lines, is a slot, through which extends a pin secured to the shaft, causing the sleeve to turn with the shaft. The sleeve has a series of recesses at each end, forming projecting teeth, as shown in Fig. 2, the teeth being adapted to fit the sockets on the inner side of each sprocket wheel, so that by sliding the sleeve one way or the other, either one of the sprocket wheels may be engaged and driven by the shaft. A hollow thumb-screw is mounted loosely on the shaft and extends through one of the sprocket wheels into the end of the sleeve, which is counterbored to receive it. The inner end of the screw is threaded to engage a threaded portion of the sleeve, and the outer end of the screw has a handle disk, by turning which the sleeve is moved to engage one of the sprocket wheels. In connecting this gear with a bicycle wheel, the latter is provided with two sprocket wheels, one on each side, and preferably of different sizes, the larger one connecting with the smaller sprocket wheel on the treadle shaft and the smaller one on the main wheel connecting with the larger of the treadle sprockets. By then shifting the sleeve, which serves as a clutch, either the larger or smaller of the treadle sprockets is engaged, according as the road is easy or difficult.

A MINIATURE ELECTRIC MOTOR.

An interesting little electric motor is the subject of our cut. It is of multipolar type, and by its construction secures a very even speed of rotation and good efficiency. It is a complete miniature of the practical every-day motor, and will, with a single cell of bichromate battery, run a 4½ in. fan and do other light work. It is of interest as marking the tendency of electric toy makers to carry out the correct principles of electric engineering in their models. Other motors of larger size are made by the manufacturers, Messrs. Goodnow & Wightman, 63 Sudbury Street, Boston, Mass., one size being powerful enough to run a sewing machine.

A VISIT TO A FAMILY IN ANNAM.

A sojourn of two days gives the passengers on the Natal ample time to visit the city of Saignon. This European city is very attractive on account of the beautiful and well kept trees that border its streets like the lanes in a park, and the pretty little hotels which line its roads. Large and handsome gardens are within easy reach and add to the pleasure of a visit there.

Thanks to the kindness of some friends who acted as guides, I was able to visit the most curious section of the district, namely, Cholon, the Chinese section, where over 60,000 Chinese and Annamites reside. They live in little picturesque houses, and adorn their shops with various exotic plants full of interest to a stranger. Guided by my friends, we visited a very rich Annamite family, who lived in one of the prettiest streets in Cholon. Unfortunately the father was away and so were the sons, who were studying in Paris. We were, however, most hospitably received by the two eldest daughters. They were attractive-looking women with beautiful eyes, but their black teeth, which were lacquered, detracted somewhat from their beauty. They were clothed in long black trousers, and with a tunic of white Chinese crepe which entirely enveloped their figures. They wore gold collars and diamond bracelets, while their hair was held in position by a golden pin that clasps their locks in a knot. After the formal presentation, we were conducted through the principal apartments of the house. They were very simple in appearance, with bare white walls, but they were filled with beautiful furniture inlaid with mother-of-pearl, and we noticed some exquisite bric-a-brac, such as chiseled silver vases, jade ornaments, arms, and embroidered silks, worthy of the finest collections. The garden was charming, and the young ladies showed us with pride some ornamental plants that their father had procured for them from Canton.

One of these represented a peacock seated on its perch, another a tiger with enameled eyes. Perhaps the most curious of all were little dolls representing Chinese ladies and mandarins. The head, the hands, and the feet were of enameled porcelain, while the body was made of wire and covered with trailing vines. The vines are planted in such a way that they grow through the feet of the image. The vine grows rapidly, and finally conceals the entire figure except the hands, feet, and head. When the figure is entirely clothed with the foliage, the effect is very fine.

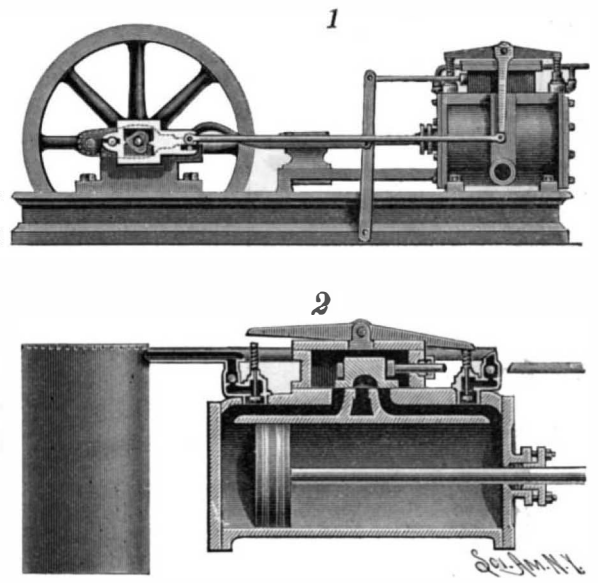
In the middle of the garden and surrounded by pools of limpid water is a pagoda of carved wood. The pavement is laid in precious marble, and its columns are of carved wood, while the roof is richly ornamented. At the rear of the pavilion there are three altars, on which are three bronze vases and braziers, in front of large gilt statues of Buddha. Our hostesses invited us to rest in this pavilion. Their mother had erected it in honor of their father during his visit to the exposition at Paris, as a surprise for him upon his return.

After refreshments were served, at our request their servants brought their jewelry, and we had a chance to admire the fine gold work that they showed us, gold bracelets, carved ivory boxes, etc.—*By Albert Tissandier, in La Nature.*

CHINESE FIGURES FROM ANNAM, FORMED BY TRAILING VINES.

AN IMPROVED ENGINE.

The engine shown in the illustration has a valve arranged at each end of the cylinder, opening previous to



CLARK'S ENGINE.

the opening of the ordinary exhaust and connected with a reservoir for the storage of exhaust steam, whereby it is designed to save a large amount of exhaust steam without causing back pressure on the piston in the cylinder. The valves at the ends of the cylinder are adapted to open inwardly, and in the valve bodies are check valves to prevent a return flow of the exhaust steam from the reservoir to the cylinder. The stems of these valves carry springs to hold the valves normally to their seats, as shown in Fig. 2, their opening being effected by the stems being alternately pressed on by the ends of a lever fulcrumed to the top plate of the steam chest. A depending arm from this lever, as shown in Fig. 1, is pivotally connected by a link with a plate sliding on the frame near the main shaft, the plate having an aperture in which travels a heart-shaped cam secured on the shaft, and adapted to strike on lugs secured on the plate and projecting into the opening. By this construction a quick motion is given to the lever which opens alternately the valves at the cylinder ends, at the time the piston is at or near the end of its stroke, and previous to the opening of the regular exhaust, the latter being effected by the ordinary slide valve operating over the usual inlet ports and the exhaust port. It is designed that the valves at the cylinder ends shall open in sufficient time to

© 1891 SCIENTIFIC AMERICAN, INC.

permit a large quantity of steam to escape to the storage reservoir, an outlet pipe from the latter carrying off the saved exhaust steam to utilize for other purposes. If desired, also, these valves, instead of opening into the exhaust ports, may be arranged in the heads of the cylinder.

This improvement has been patented by Mr. Andrew J. Clark, of Dayton, Tenn.

THE ASSAYING OF GOLD AND SILVER ORES.

The process of assaying silver ores is based upon the following considerations: Any compound of silver exposed to high heat in the presence of metallic lead or of oxide of lead and of a reducing agent gives up its silver in a metallic state, and in practice an alloy of lead and silver containing all the precious metal of the sample of ore used is obtained.

The ore before being assayed is carefully sampled, so as to represent an exact average, as nearly as possible, of the mine, vein, or heap from which it is taken. It is next pounded in an iron mortar and the process continued until it is very finely pulverized. A sample is thus obtained which is given to the assayer.

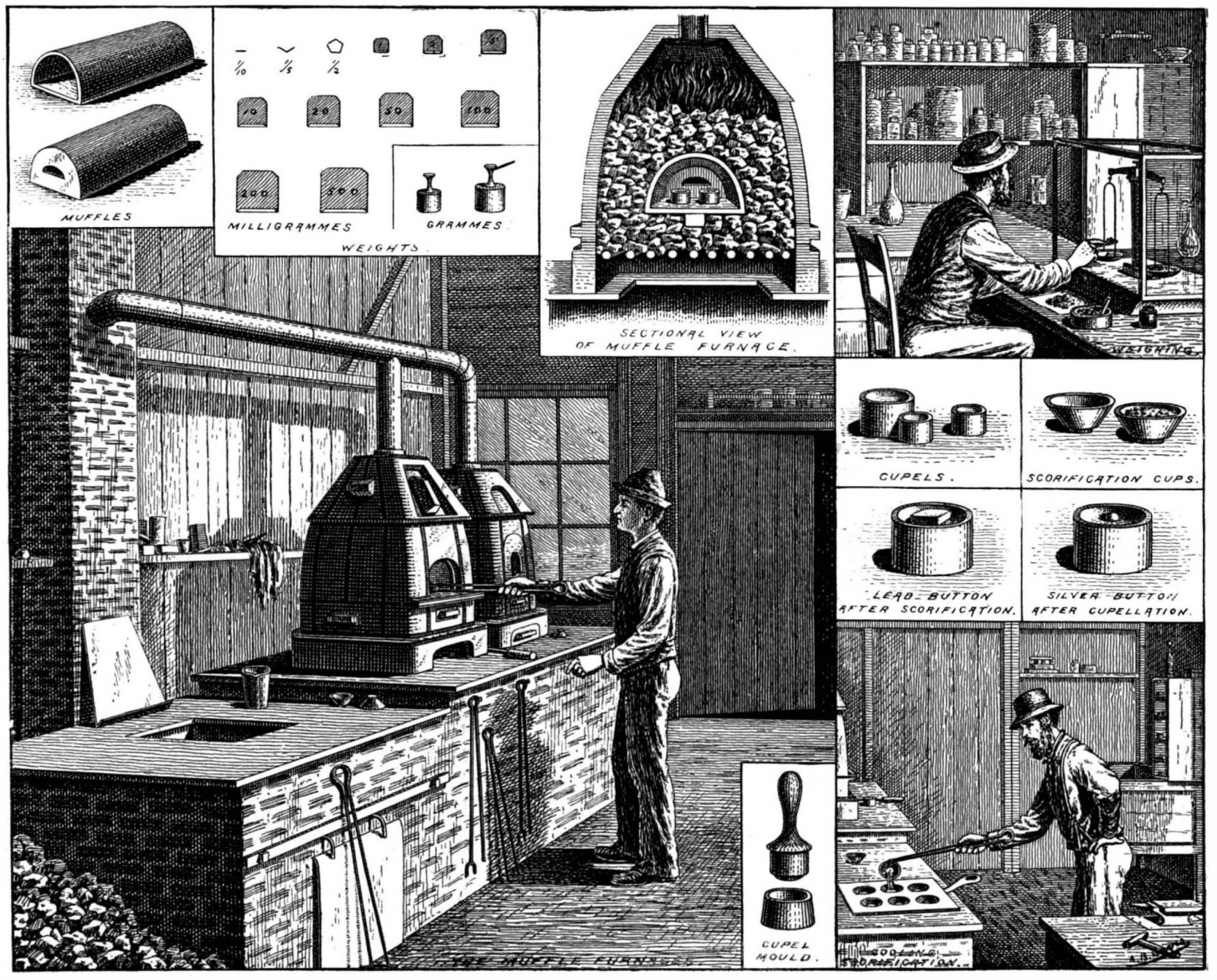
The first operation is to weigh out the powder. This must be done upon a fairly delicate balance. The quantity used for an assay depends upon the richness of the ore; it is very usual to base the weighing upon what is known as the assay ton, a weight of 29·166 grammes. One milligramme bears the same proportion to the assay ton that one troy ounce does to a ton of 2,000 pounds. In weighing, duplicate portions are weighed out representing from a fraction of one to several assay tons, according to the richness of the ore, and the operations are carried on in duplicate throughout. Each sample is mixed with from 8 to 16 parts of very pure, finely granulated lead, called "test lead," and a little borax glass. The fusion is often done directly in a scorifier. These are shallow clay cups about 2 inches and 2¾ inches in width. The weighed portion of ore with the borax glass and lead being placed in one of these cups, the whole is introduced into a hot clay retort known as a muffle, which is heated in a muffle furnace. Muffles and furnaces are shown in the cuts in sections and elevations. The heat is maintained at about 1,600 degrees. The lead in the scorifier melts and the ore floats on top of it, along with the melted borax glass. Gradually the ore disappears, its metallic constituents entering the lead and its earthy constituents forming with the borax glass a fusible slag. As a constant current of air is drawn through the muffle, the lead rapidly oxidizes and its oxide joins the slag, so that after a little while only a small circle of metallic lead appears in the center of the slag. This circle is gradually encroached upon, and eventually the slag covers over the button of metal, which at once sinks to the bottom and the scorifying is ended. After a little more heating the scorifier is withdrawn from the muffle and its melted charge is poured out into a hemispherical depression in an iron pan, in which it rapidly cools. When cold, a few blows of the hammer, the charge resting on an anvil, knocks the slag off. The spheroidal lead button is then pounded into a roughly rectangular shape, and is ready for cupellation.

The cupels are shallow cups of bone ash, about 1½ in. in height, 2¼ in. in width and ⅜ in. in depth. They are made by hammering in a mould, a hammer and piston being used to drive the material down into the cavity of the mould and compact it. The cupel is first heated in a muffle and the rectangular button is placed in it. It at once melts and begins to oxidize. As fast as the oxide of lead is formed, it melts and is absorbed by the porous bone ash of the cupel, as water is absorbed by a sponge. This operation goes on until little more than the silver is left. Just at this point, as the last of the oxide of lead disappears, a sudden flash of rainbow colors passes across the surface of the button, the "brightening" indicating the expulsion of the last of the lead. The silver button is now allowed to cool, is removed by a pair of pincers from the cupel, and when cleaned and brushed free of bone ash is weighed on an exceedingly sensitive balance. Each milligramme of weight represents an ounce or definite portion of an ounce per ton of ore if assay tons have been used. The balance used for this weighing is one of the most sensitive made, and can indicate the twentieth of a milligramme readily.

Should the ore contain gold, this is determined by "parting." The button is fused with one or two times its weight of pure silver. It is then rolled out into a thin sheet, and is treated with nitric acid. This dissolves the silver and leaves behind the gold and any platinum or similar metal which the ore may contain. This residue is weighed and is reported as gold.

The weights used, from the gramme upward, are usually made of brass, of the shape shown. From 500 milligrammes down to 10 milligrammes they are often made of platinum; the smaller weights are of aluminum, the fractions of a milligramme being made of wire bent so that the number of sides in each bent wires indicates the number of tenths of a milligramme which it represents.

There are, of course, many refinements and modifications in the process which it is not necessary to summarize here. The assayer acquires by practice so good a knowledge of ores that he can properly proportion his charge from the appearance of the ore alone. A large number of assays can be kept going at once, the scorifiers and cupels being marked with numbers designating the sample for assaying which it is used.



THE ASSAYING OF GOLD AND SILVER ORES.

American Copyright.

It is a great mistake to suppose that the copyright difficulty with America has been settled. The new American act comes into operation this day month, but we shall then be no better off than we are now. Before the British author can enjoy the benefits of the measure, such as they are, we are expected to give reciprocity to the American author, who is to be placed on exactly the same footing, as regards copyright, as the English writer. That would be fair enough were the conditions equal, but Congress has taken care that they shall be very far from equal. For an English book to obtain copyright in the United States it is essential that it should be printed there. Yet, in face of this, Mr. R. B. Marston appeals to Parliament to grant reciprocity to America. What Parliament ought to do is not to grant a ridiculously one-sided reciprocity, but to pass a measure of retaliation. Let us give copyright to the American author on precisely the same terms that America offers it to the Englishman. Nothing can be fairer than that.—*St. James's Gazette*.

© 1891 SCIENTIFIC AMERICAN, INC.

THE COLUMBIAN WORLD'S FAIR, 1893.

So great was the strife for the Fair site, and so prolonged the dissensions between the Chicagoans themselves and between them and the National Commissioners after it had been decided that the Fair should be held in Chicago, that it is probable few people are prepared to fully realize the great amount of work which has been already done in practical preparation for the Fair, and the bright prospect at present ahead that the Exhibition will be promptly opened in the spring of 1893. The financial outlook, on which all else mainly depends, has already come down to a solid basis of nearly ten million dollars of appropriations for the Fair, including those from the several States, the city of Chicago, and the General Government—although many States which are certain to make large appropriations have not as yet taken final action. In addition to this sum the managers of the Fair count upon very large prospective resources from the gate receipts, from concessions and privileges, and from salvage. The resources obtainable from the last three sources were estimated on April 1, by Mr. Lyman J. Gage, of the First National Bank of Chicago, and President of the Exposition Company during its first year, as high as eleven million dollars. This showing undoubtedly affords a large financial basis on which to proceed in the erection of buildings and preparing for a great display, and that the time which has thus far elapsed has not been unprofitably occupied by the management is proved by the published plans of buildings and arrangements. These have been so far completed that almost everything in the way of buildings is ready for the contractors' estimates, while contracts for some of the main buildings are already awarded.

The work of preparing the grounds, consisting of some 600 hundred acres of uneven park land, has been virtually completed, except the dredging of the lagoon, the canal, and the basin, which the contracts specify shall be finished early in July. About seventy acres of the grounds were covered by oak trees, which had to be cut down, and the black earth from this tract collected and spread, 85,000 cubic yards being put on and around the site of the natural island, and 120,000 yards on the territory south of the buildings. The ground level or grade of the grounds is 4½ feet above datum, or about 5½ feet above the level of the lake. On the 4½ foot grade are the sites for the liberal arts, fisheries, government, agriculture, machinery, and electricity buildings. The horticulture, transportation, and woman's buildings are on the 6 foot level, the machinery and mines buildings on the 7 foot level, while the administration building is 14 feet above datum, or about 10 feet above the grade of the grounds. About 600 men, 225 teams, and 6 dredges have been at work most of the time since April 1, the dredges being operated night and day, and the earth thrown up by them being used to fill in building sites and uneven areas of the grounds. The basin being excavated will be about 1,500 feet long by 350 feet wide, and will intersect a canal half a mile in length and 150 feet wide. The banks of the canal and basin will be architecturally treated, while the shores of the lagoon will be natural and receive landscape treatment.

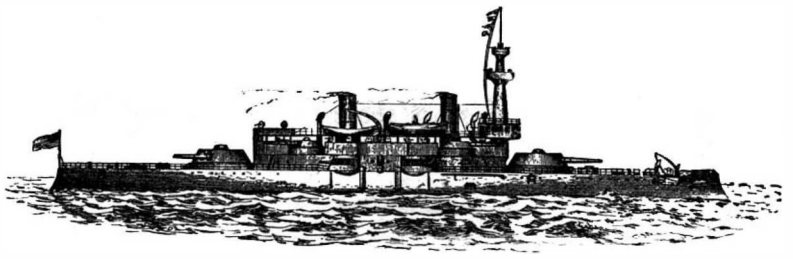
Although nearly all of the Fair buildings will be in Jackson Park, in which the lagoon, canal and basin are located, as shown in our views, Washington Park is also included in the Fair grounds, and the Midway Plaisance, 600 feet wide, connecting the two, in all 1,037 acres. Jackson Park has a frontage of two miles on Lake Michigan, and the two parks are connected with the center of the city and its general park and boulevard system by more than 35 miles of boulevards from 100 to 300 feet in width. The Fair grounds are all within the limits of the city of Chicago, about seven miles south of the City Hall, and it is expected that the transportation facilities, by means of steam roads and horse cars, and by lake steamers, will be of the most ample description.

The trunk lines from every section of the country have their termini but a short distance from the grounds, while the ample lake front will afford abundant room for the accommodation of excursion steamers from every port on the great lakes.

The fact that the principal buildings are all so near the lake also makes it particularly appropriate that, as a portion of the government exhibit, a full-sized model of one of the new coast-line battle ships be shown here. To all outward appearances it will be a genuine battle ship. It will rest on a foundation of piles, and will be surrounded by water, having the appearance of being moored to a dock. It will be built of brick, covered with concrete. It will serve the double purpose of housing the naval exhibit and showing how our sailors live aboard ship. The dimensions of the structure will be those of the actual battle ship—343 feet long and 69 feet 3 inches wide amidships. It will carry no sails nor spars. It will cost about $100,000, whereas the ships of which it is to be an exact model cost $3,000,000. It will present a complete object lesson, and prove that the sailors of the United States Navy are the best paid, best fed, and best treated sailors in the world.

THE MACHINERY HALL.

The structure will have all the fittings that belong to the actual ship, such as guns, turrets, torpedo tubes, torpedo nets and booms, with boats, anchors, chain cables, davits, awnings, deck fittings, etc., together with all appliances for working the same. Officers, seamen, mechanics, and marines will be detailed by the Navy Department during the exposition, and the discipline and mode of life on our naval vessels will be completely shown. The detail of men will not, however, be as great as the complement of the actual ship, the object being mainly to have expert janitors and showmen for the valuable public property. It is expected, however, to give certain drills, especially boat, torpedo and gun drills, as in a vessel of war.

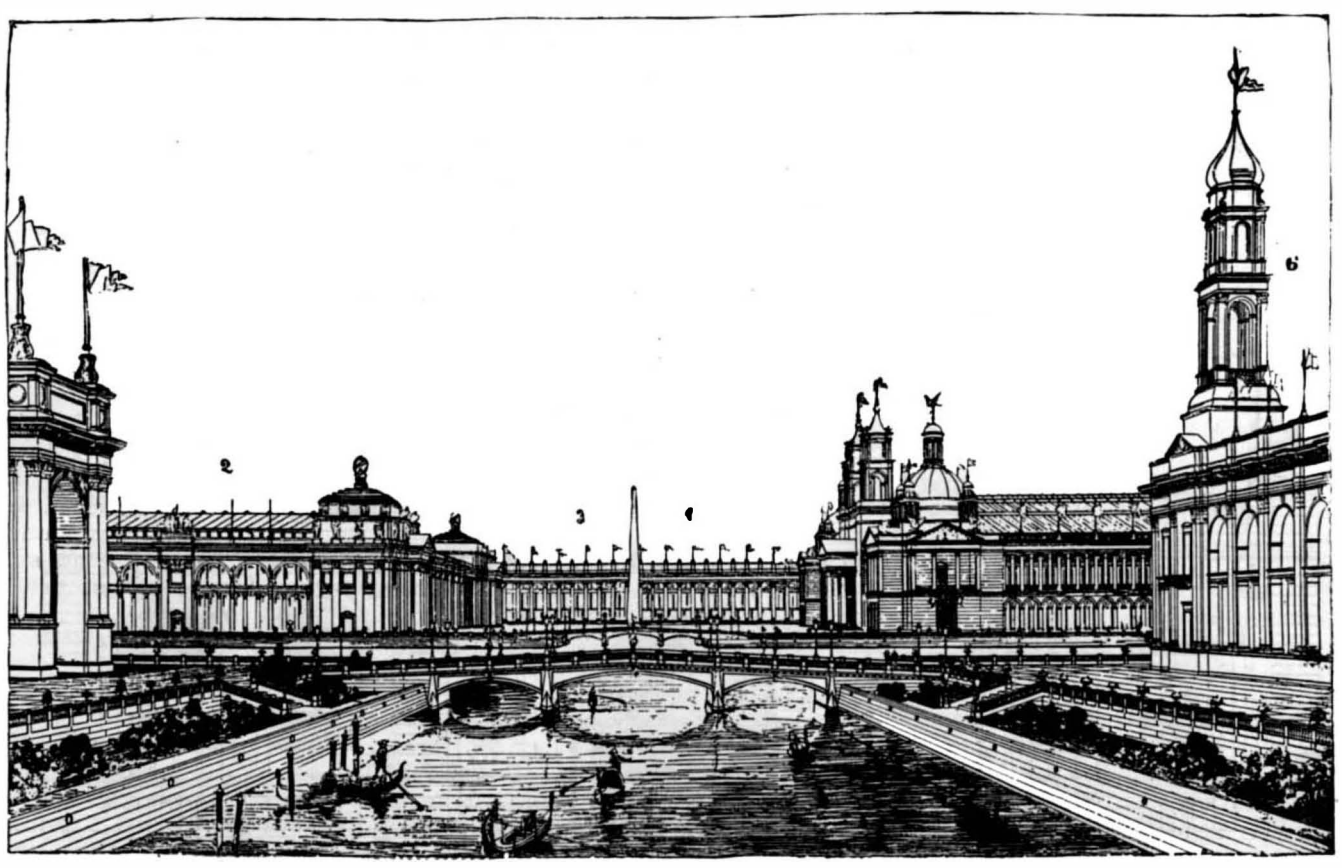


MODEL OF THE BATTLE SHIP ILLINOIS.

The main machinery building, represented in one of our views, and of which Peabody & Stearns, of Boston, are the architects, has received very high praise, which is apparently well deserved. It will be 850 by 500 feet, and cost $450,000. It is located at the extreme south end of the park, midway between the shore of Lake Michigan and the west line of the park. It is just south of the Administration building, and its northwest corner approaches within a few rods of the big transportation loop.

The building is spanned by three arched trusses and the interior will present the appearance of three railroad train houses side by side, surrounded on all of the four exterior sides by a fifty foot gallery. The trusses are to be built separately, so that they can be taken down and sold for use as railroad train houses. In each of these long naves there is to be an elevated traveling crane running from end to end of the building for the purpose of moving machinery. These platforms will be built when the exposition opens, so that the visitors may view from them the exhibitions beneath. Steam power for this building will be supplied from a power house adjoining the south side of the building. The two exterior sides adjoining the grand court are to be rich and palatial in appearance.

All of the buildings on this grand plaza are designed with a view to making a grand background for displays, and in order to conform to the general richness of the court and add to the festal



VIEW OF LAGOON.

© 1891 SCIENTIFIC AMERICAN, INC.

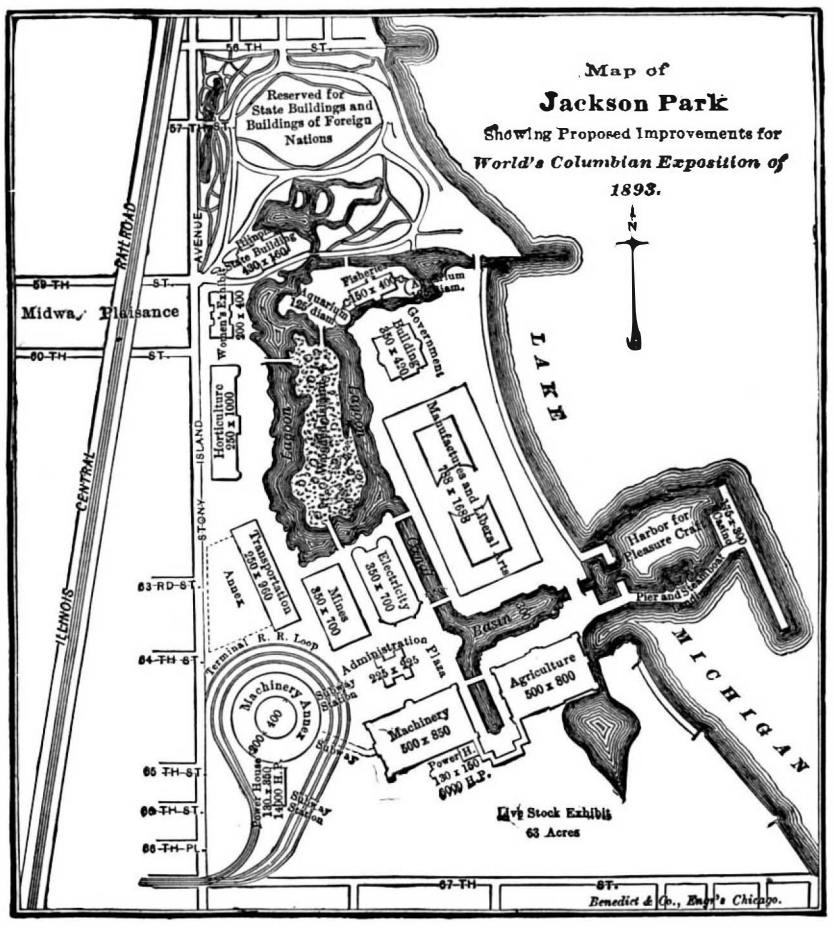
appearance, the two facades of the Machinery Hall on the court are rich with colonnades and other features. The design follows classical models throughout, the details being followed from the renaissance of Seville and other Spanish towns, as being appropriate to a Columbian celebration. An arcade on the first story admits passage around the building under cover, and, as in all the other buildings, the front will be formed of staff colored to an ivory tone; the ceilings will be enriched with strong color. A colonnade with a café at either end forms the length between Machinery and Agricultural halls, and in the center of this colonnade is an archway leading to the cattle exhibit. From this portico there will be a view nearly a mile in length down the lagoon, and an obelisk and fountain in the lagoon will form the southern point of this vista.

The Machinery Annex will stand inside the great transportation loop, west of the Administration Building, unless the plans are changed so that the Electrical Building may occupy that space, as the electricians desire. The annex will cover nearly nine acres. It will be entered by tunnels and bridges from the Machinery Hall and the Administration, Mines, and Transportation buildings. It is to be a simple building, built of wood in an economic manner. Its type is that of a mill or foundry. It is to be annular in form, the diameter being 800 feet. In the inner circle will be a park, in which visitors, fatigued by the hum of machinery, may rest. The annular form chiefly commends itself, because the circle of the electrical elevated railway can run constantly around the entire main nave, and passengers in it can thus see the exposition without leaving the cars. Electrical power will be used in the annex and steam power in the main building.

Attached to this great annex will be the power house, containing the tremendous display of boilers, while in the adjoining portion of the annex building will be established the voluminous plant of engines and dynamos. This will be the largest and most interesting display of electrical power ever made. It is possible that gas may be used beneath the boilers instead of coal for fuel.

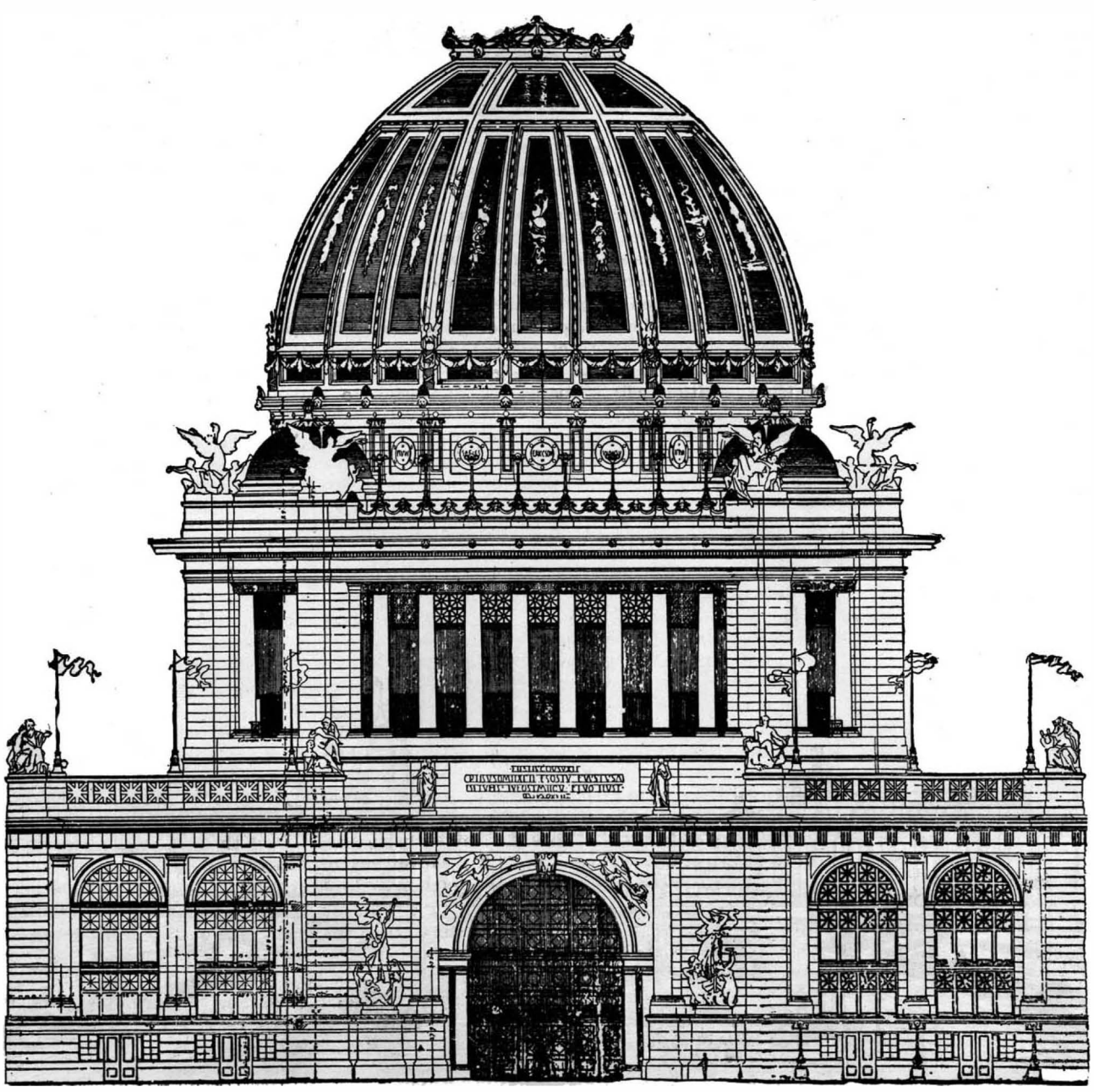
The Administration Building is said to be, architecturally, the gem of the Exposition. It will be located at the west end of the great court in the southern part of the site, looking eastward, at the rear of which will be the railroad loop and the great passenger depot. The first object which will attract visitors on reaching the grounds will be the gilded dome of this great building. To the south of the Administration Building will be the Machinery Hall, and across the great court in front will be the Agricultural Building to the south and the Manufacturers' Building to the northeast.

The Administration Building will cost $650,000, and is constructed of material to endure but two years. The architect is Richard M. Hunt, of New York, President of the American Institute of Architects. It will cover an area of 250 feet square and consist of four pavilions, 84 feet square, one at each of the four angles of the square of the plan and connected by a great central dome 120 feet in diameter and 220 feet in height, leaving at the center of each facade a recess 82 feet wide, within which will be one of the grand entrances to the building. The general design is in the style of the French renaissance, and it will be a dignified and beautiful specimen of architecture as befits its position and purpose among the various structures by which it will be surrounded. The first great story will be in the Doric order, of heroic proportions, surrounded by a lofty balustrade and having the great tiers of the angle of each pavilion crowned with sculpture. The second story, with its lofty and spacious colonnade, will be of the Ionic order.



Externally the design may be divided in its height into three principal stages. The first stage consists of the four pavilions, corresponding in height with the various buildings grouped about it, which are about sixty-five feet high. The second stage, which is of the same height, is a continuation of the central rotunda, 175 feet square, surrounded on all sides by an open colonnade of noble proportions, it being 20 feet wide and 40 feet high, with columns 4 feet in diameter. This colonnade is reached by staircases and elevators from the four principal halls and is interrupted at the angles by corner pavilions, crowned with domes and groups of statuary. The third stage consists of the base of the great dome, 30 feet in height, and octagonal in form, and the dome itself, rising in graceful lines, richly ornamented with heavily moulded ribs and sculptural panels and having a large skylight of glass to light the interior. At each angle of the octagonal base are large sculptured eagles, and among the springing lines are panels with rich garlands. The interior features of the building will even exceed in beauty and splendor those of the exterior.

In this building each of the corner pavilions, which are four stories in height, will be divided into offices for the various departments of the administration, and lobbies and toilet rooms. The ground floor contains, in one pavilion, the Fire and Police Departments, with cells for the detention of prisoners; in the second pavilion, the offices of the ambulance service, the physician and pharmacy, the Foreign Department and the Information Bureau; in the third pavilion, the post office and a bank; and in the fourth, the offices of public comfort and a restaurant. The second, third, and fourth stories will contain the board rooms, the committee rooms, the rooms of the director general, of the Department of Publicity and Promotion, and of the United States Columbian Commission.



ADMINISTRATION BUILDING.

Small Propeller Screws the Best.

"The small size of the screw," said a boiler maker to a representative of the N. Y. *Tribune*, "is not due to the perception of any inventor of its greater effect as compared with a larger one, but purely to accident. When I first engaged in the machinery business, screws for steamers were made as large as possible, it being the theory that the greater the diameter, the higher the speed. A vessel was placed on Lake Erie with a screw so large that it was deemed best to cast each blade in two parts, and then weld them together. During a storm all these blades of the propeller broke at the welding, reducing the diameter by more than two-thirds. To the surprise of the captain the vessel shot forward at a speed such as had never been attained before. Engineers then experimented with small propellers and discovered that they were much more effective than large ones.

CUNLIFFE LISTER, one of the new English peers, laid the foundation of his great wealth by mechanical inventions. His first great hit was a wool-combing machine, and his second was a device for utilizing silk waste, which had previously been sold at a cent a pound, in making silk plush. Unlike many of this class of men, he did not begin life a poor boy, but had a father endowed with sense and means, who gave him a mill instead of a university education. Originally it was intended to make a parson of him—the usual destiny of a fourth son of a country gentleman.

© 1891 SCIENTIFIC AMERICAN, INC.

The Phosphate Beds of Our Southern States.

BY FRANCIS WYATT, PH.D.

The chemistry of agriculture is that branch of the science which investigates into the nature and properties of soils and plants and which determines the relation of one to the other and the veritable composition of each. If we hand over a grain of wheat to the botanist, he can discern in it nothing but a tiny, yellow opaque, and brittle seed, whereas if we pass it to the chemist, he will discover by analysis that it is composed of a woody fiber, starch, gum, sugar, fat and protein. Again, a geologist may examine the soil, and designate the different ages to which it belongs and the various rocks from which it is derived, but without the chemist, he is unable to determine its actual constituents, and hence, cannot foretell, before any cultivation has been attempted, whether it is destined to be fertile, or of what kind of vegetation it is best able to promote the growth.

The application of chemistry to agriculture is thus naturally indicated. By its aid we obtain from the soil and from plants, at the lowest possible expenditure of time and money, the highest possible quantity of those substances indispensable to our physical well-being.

If production is to be cheap, it must be rapid and plenteous, yet, as we all know the progress of unaided nature is slow and methodical, and so, chemistry, by investigating the laws which govern the development of all living things, and by carefully observing the facts acquired by the practical experience of centuries, has found the means by which the farmer may assist and hasten the natural processes. The work is, of course, still far from complete, but we are at least familiar with the elements essential to plant growth. We know how these elements are distributed, what portion of them is or should be contained in our soils, and what soils are most propitious for different kinds of plants.

Sixty years ago the science of agriculture was unknown. Our grandfathers could not understand why lands once so fertile and productive should show signs of approaching exhaustion. The light only came to us after we had studied how outdoor plants live, whence they obtain their food, of what elements that food is composed, and how it is conveyed and absorbed into their organisms. In point of fact we have discovered that the manner of life in plants is very similar to the manner of life in animals and man. They require certain foods in stated proportions which pass through the process of digestion; they must breathe a certain atmosphere, and they are subject to the influences of heat and cold, light and darkness.

The tissues of their bodies, like ours, are composed of carbon, hydrogen, oxygen, nitrogen, and certain mineral acids and bases, such as phosphoric and sulphuric acids, lime, potash, magnesia, and iron. Since, therefore, it is admittedly necessary for man to constantly absorb a sufficiency of these elements in the form of food, it follows that similar food is required by plants for similar purposes.

Having determined the elementary composition of plants, investigators directed their attention to the analysis of soils, in order to establish comparisons between virgin or uncultivated lands and old varieties which had long been tributaries to every kind of culture.

It was found that in the former there is an abundance of most of the dominating mineral ingredients discovered in plant organisms, whereas in the latter they either exist only in minute proportions or are lacking altogether.

This is a most important stage in our progress! Argument is no longer necessary to prove that if agriculture is to continue to be the basis of national wealth and prosperity, means must be found of restoring to our soils the chief mineral element yearly taken away from them by the crops. This chief mineral element is phosphoric acid; and, since it plays the most important part in the functions of vegetation, it is necessarily the one most liable to be rapidly exhausted.

The following figures, compiled from official reports, will serve to emphasize the argument:

PHOSPHORIC ACID TAKEN FROM THE SOIL PER ACRE AND PER ANNUM.

An average crop of	wheat	takes	30	pounds.
"	maize	"	80	"
"	oats	"	18	"
"	barley	"	18	"
"	rye	"	25	"
"	buckwheat	"	40	"
"	hay	"	15	"
"	turnips	"	45	"
"	potatoes	"	52	"

These are, of course, only a few examples, but they will suffice for present purposes, and it is perhaps hardly necessary to add that if, according to the nature of the crop desired, a sufficient proportion of phosphoric acid be not present in the soil, the plants will languish, various malignant diseases will declare themselves, and death will inevitably ensue before they reach maturity.

Now comes the practical question: How may all this loss be repaired, and whence are we to derive all the phosphoric acid needed to repair it? The equally practical answer is: By hastening to further develop our immense deposits of phosphate of lime!

It was somewhere near the beginning of the present century that the farmers of England began to use crushed bones as a manure. Just why and how they had been brought to do so is shown in an article published in a scientific journal in the year 1830, the writer saying: "As to the earthy matter or phosphate of lime contained in the bones, we may disregard it. It is insoluble and indestructible, and cannot serve as a manure, even in a damp soil and with a combination of circumstances analytically stronger than any of our known chemical processes. . . . . The fact is, that bones, after having undergone a certain internal process of fermentation, ultimately contain about two per cent of gelatine. As this is the only substance to which they can owe any fertilizing activity, they may be practically looked upon as valueless."

These were the opinions of sixty years ago! They were born of ignorance and were fostered by vanity and prejudice. Sixty years hence, what will our own successors think of our knowledge of the same subject? All generations produce some thinking men, and thus, thirteen years after the publication of the article just quoted, that is to say in the year 1843, the light came! The Duke of Richmond was a practical and enthusiastic farmer; he made an exhaustive series of experiments on his soils with fresh and degelatinized bones. His results proved beyond doubt that they both owed their virtue, not to gelatine, or fatty matters, *but to their large percentage of phosphoric acid!* Other investigators—notably Boussingault—having confirmed and elaborated the Duke's conclusions, there was soon such a run upon bones as to exhaust the rather limited supply. Attention was thus drawn to the deposits of mineral phosphates which had been already discovered in several directions, and thence may be dated the development of phosphate mining as an industry, the pursuit of which has proved so remunerative to capital and labor. The mode of occurrence of the best known deposits of phosphate of lime may well be termed eccentric. They have been found in rocks of all ages and of nearly every texture. Sometimes they are very pure, sometimes their combinations are extremely variable. Here they are found in veins, there in pockets, and here again in stratified layers or beds in connection with fossilized *debris* of all kinds deposited by the ancient seas. England, France, Germany, Belgium, Spain, Portugal, Norway, Russia, the West Indies, Canada, etc., all have workable and more or less productive phosphate mines, the commercial value of the products being estimated on the basis of their contents in tricalcium phosphate, the latter ranging from 35 to 95 per cent.

The circumstance that farmers are not in a position to restore to their soils year by year in a natural form all the phosphoric acid taken from them by their crops has caused the demand for phosphatic manures to go on increasing with such steadiness and rapidity that the sources of supply, even for European necessities, have latterly become quite inadequate. Fresh deposits of the material are, therefore, being sought after with industrious care all the world over, and attention has thus been specially directed from abroad as well as from at home to the practically inexhaustible deposits of this country.

Such being the case, a brief outline of the mode of occurrence in our chief centers of production, together with some outlines of the methods of mining, preparation for the market, mining cost, and facilities of transportation, will probably be interesting to a large number of readers.

With the theories which have been formulated from time to time by different authorities as to the true *origin* of all these deposits I shall have nothing to do; but, after describing those which I have personally examined, I shall present my own opinions and conclusions, based on a study of the various exploitations and on the results of my own chemical and physical examinations of samples which I have personally selected.

The Tertiary strata, in which our workable phosphate deposits are found, may be broadly said to hug the coast of the Atlantic Ocean and the Gulf of Mexico from New Jersey to Texas; the phosphate itself, however, according to the present state of our knowledge, being most plentiful in South Carolina and in Florida. The discovery of the South Carolina phosphates dates back as far as 1860; but it was not until some seven or eight years later than this that a mining company could be organized to test the practicability of working them on the commercial scale. Since the eminently successful initiative of this pioneer company, however, the industry has progressed with such leaps and bounds that at the present time some twenty wealthy corporations are actually engaged in it, and have thus raised the status of South Carolina to that of the most productive phosphate region in the world. The geological formation of what is commonly called its phosphate "belt" is made up of quaternary sands and clays. These overlie the beds of Eocene marls, upon whose surface and intermixed with which is found the phosphate deposit. The presumed total area covered by this characteristic formation is 70 miles in length and 30 miles in width, extending from the mouth of Broad River, near Port Royal, in the southeast, to the head waters of the Wando River in the northeast. Its major axis is parallel to the coast, and its greatest width is in the neighborhood of Charleston.

Whether the deposit is continuous or not over the whole of this zone, it certainly varies considerably in depth and thickness. In many places I have seen it 3 feet thick and cropping out at the surface, whereas in others it has dwindled down to a few inches, or was found at depths varying from 3 to 20 feet. These two conditions, thickness of deposit and depth of strata, taken together with the richness of material in phosphoric acid, are the chief points for consideration in the economic working of the Charleston phosphate beds on an industrial scale.

The most approved and generally adopted method of ascertaining the importance and value of the deposits is that of boring and pit sinking. A careful topographical survey is first made of the country. Then commences a systematic series of bore holes from any point that may be arranged, by means of a long steel borer or rod, specially designed for the purpose. The boring rod is worked down through the upper strata until it is arrested by the solid bed of phosphate. Directly the slightest resistance is offered to its passage it is drawn up, and the distance it has traversed is measured with a foot rule. The measurement having been noted, the rod is again let down, is forced through the resisting strata, and is then again withdrawn and measured. The difference between the first and second measurements is taken as representing the thickness of the phosphate bed. These bore holes are practiced at distances of 100 feet apart over the total surface to be examined. The results obtained with the rod are verified and confirmed by a series of exploratory pits—10 feet long by 5 feet wide—which are dug over the course of the bore holes at intervals of 500 feet. The bore holes are driven to a maximum depth of 15 feet, and no pits are at present sunk on those portions of the land where at that distance no phosphate has been encountered. Immediately after removing the overlying strata the phosphate is carefully removed, its depth and thickness measured, and an average sample of the rock and nodules secured and laid aside for analysis.

The practically invariable nature of the superincumbent material, throughout the entire belt, as shown by the digging of a large number of pits under my direction, is represented in the following table, the figures being averages, compiled from my field note book:

	Cainhoy.	Jacksonboro.	Edisto.	Ashley.
	Feet.	Feet.	Feet.	Feet.
Soil very black and acid.	1½	1½	1	2
Mixture of sand and blue clay	2	3½	4	1½
Silicious clay	2½	2½	3½	4
Potters' clay mixed with shells	2	1½	3½	1¼
Sandy, hard conglomerate	traces	½	¾	2½
Phosphate rock or nodules mixed with blue clay	1½	1¼	1½	1¼
Depth of overlying beds.	8	9½	12¾	11¼

So far as I have been able to discover, no systematical investigation has been made of those lands which contain the phosphate deposit at a greater maximum depth than 15 feet, it having been hitherto considered impracticable under present conditions of abundant surface supply, and consequent low mining cost, to conduct a profitable exploitation at any greater depth. A far wider area of lands than those actually classed as mining properties may contain the very same deposit of phosphate, lying under a considerably greater accumulation of the quaternary strata. I am quite disposed to adopt this view as representing the facts, and do not hesitate to predict that means will soon be found of turning them to good account. The phosphate found in the bottoms of all the rivers which flow through the "belt" is of practically the same chemical description as that of the land; having, in fact, been merely washed out from its original beds. It has, however, been worked the more extensively of the two sources, and has proved to be of greater commercial value, since it is obtained by the simple and inexpensive progress of dredging, and is thus raised and washed free from all adhering impurities by one and the same operation.

Both the rock and nodules from these rivers and land deposits occur in very irregular masses or blocks of extremely hard conglomerate of variegated colors, weighing from less than half an ounce to more than a ton. The mean specific gravity of the material is 2·40, and the rock is bored in all directions by very small holes. These holes are the work of innumerable crustaceæ, and are now filled with sands and clays of the overlying strata. Sometimes the rock is quite smooth or even glazed, as if worn by water, at others it is rough and jagged.

Interspersed between the nodules and lumps of conglomerate are the fossilized remains of various species

© 1891 SCIENTIFIC AMERICAN, INC.

of fish, and some animals, chiefly belonging to the Eocene, Pliocene, or post-Pliocene ages.

Very careful analysis of a large number of the samples of land rocks taken from the pits above described, made in my laboratory, under my own supervision, gave, after being well dried at 212° F., the following averages:

Moisture, water of combination, and organic matter lost on ignition	8·00
Phosphate of lime	57·63
Carbonate of lime	8·68
Phosphate of iron and alumina	6·60
Carbonate of magnesia	0·78
Sulphuric acid and fluorine	1·80
Sand, siliceous matters and undetermined	10·64
	100·00

These figures suffice to show that the grade of this phosphate is not extremely high, but it is admirably adapted for the purpose of manufacturing commercial fertilizers, and will, therefore, long continue to maintain a leading position as a raw material in the markets of the world.

Before it can be made available for industrial purposes, it is made to pass through three distinct and successive operations: 1. Mining or excavating. 2. Washing it free from sand and other impurities. 3. Kilning, to free it from moisture. Taking these in their order, it is customary to establish a main trunk railroad starting at the river front, or on the bank of some convenient stream, and passing right through the center of the property to be exploited.

Alternate laterals can be run off at right angles from any portion of this main line, at distances of say 500 feet, in conformity with the nature of the ground. Between and parallel to these laterals, a ditch or drain is dug to a depth extending 4 or 5 feet below the phosphate strata. From this main drain the excavators start their lines at right angles to the laterals, commencing at one end of the field and digging trenches 15 feet wide and 500 feet long, the work being so arranged that the men are stationed at intervals of 6 feet. Every man is supposed to dig out, daily, "a pit" 6 feet long, 15 feet wide, and down to the phosphate rock. The overlying material is thrown out to the left hand side of the trench. The phosphate itself is thrown out to the right, and taken in wheelbarrows to the railroad cars which pass at either end of the trench. The water drains from the trenches into the underlying ditch, and is then pumped out by means of a steam pump worked by a locomotive engine. The pump and the engine are secured to connected railway platforms, and run along the railroad track, from one ditch to another, as occasion requires. The cars, loaded with the crude phosphatic material dug out of the pits, are run down to the washing apparatus, constructed at an elevation of some 30 feet from the ground, and generally consisting of a series of semicircular troughs 20 to 30 feet long, set in an iron framework at an incline of some 20 inches rise in their length.

Through every trough passes an octagonal iron-cased shaft, provided with blades so arranged and distributed as to form a screw with a twist of one foot in six, which forces the washed material upward and projects the fragments against each other. The phosphate laden cars are hauled up an incline and their contents dumped into the bottom trough, where the phosphate encounters one or more heavy streams of water, pumped up by a steam pump. This water does not run off at the bottom, but overflows at the higher end near where it enters. When sufficiently washed, the phosphate is pushed out upon a one-half inch mesh screen; the small debris being received on oscillating wire tables below. It is now ready for kilning or drying, and of all the methods hitherto adopted for this important process, that of simple *burning* or *roasting*, in an ordinary kiln, such as is generally used in the manufacture of bricks, has been found at once the most rapid, effective and economical.

The rock is built on layers of pine wood, and owing to its containing a considerable quantity of organic matter, it readily lends itself to combustion and requires but a short time to become quite red hot.

The kilns are made sufficiently large and so arranged as to allow free passage to a train of cars, which, running on the main line of railroad, can be loaded in the kiln, run down to the landing place, and discharged directly into the barges or boats on the river. With a properly constructed plant, regular drainage, and efficient management, the total cost of producing one ton of South Carolina phosphate in clean, dry, marketable condition is about $3.50 per ton, made up as follows:

Mining, at a maximum depth of 15 feet	$1.00
Draining the mine	25
Loading on cars and carrying to washer	60
Washing	30
Drying and handling in kiln	50
Shipping from kiln into vessels on river	25
Interest on capital invested in plant and repairs to same	15
Superintendence and management of mines	20
Towage to Charleston, say	25
Total per ton of 2,240 lb	$3.50

The present selling price for dry phosphate, with an average mean analysis of 57 per cent tribasic or bone phosphate of lime is $7 per ton of 2,240 lb. on wharf at Charleston.

As I have already said, the quantity of phosphate mined and sold in South Carolina during the past few years has been continually increasing until it has now reached the figure of about 500,000 tons per annum. Assuming that the unexploited deposits still cover an area of some thirty miles, and that they will yield the present average of 750 tons of phosphate to the acre, we may count upon a reserve of about 14,000,000 tons. With a constantly growing demand for "fertilizer" purposes, it would, therefore, seem as if the mining resources of the State would be exhausted in from fifteen to twenty years.

With a probable appreciation of these figures and facts, the efforts of the wealthiest mining companies now in the field are naturally directed toward the appropriation of all available and readily accessible deposits, and there is no doubt that while acquired on reasonable terms and worked with economy their exploitation will continue to be attended with very profitable results.

The dividends distributed during the past year by some of the companies, whose figures have been published, amounted to a trifle less than $500,000, and it is significant of the rapid intellectual growth and commercial and industrial development of the South that of the total phosphate mined in the State, more than one-fifth is actually used in Charleston for manufacturing purposes. About one-third of the balance is exported to Great Britain and Germany, and the remainder is principally sent coastwise to Richmond, Baltimore, Philadelphia and New York.

When the great benefits accruing to South Carolina and its people from this industry are appreciated, it will not appear strange that active search for phosphate beds of similar value should have been stimulated in the adjoining States, and that the most intense, not to say mad, excitement has manifested itself since the discovery some two years ago of the Florida phosphate deposits.

Note.—The Florida phosphate beds will be fully treated in the following article.

(To be continued.)

THE glaze upon enameled cards is made by pressure upon a polished plate or rollers. The composition is chalk, clay, and a little starch. Good work is not possible without elaborate accessories.

RECENTLY PATENTED INVENTIONS.

Engineering.

SYSTEM OF STREET CAR PROPULSION.—Frederick G. Wheeler, Montclair, N. J. Combined with the engine cylinders is a water chamber and a system of circulating pipes, with condensers arranged in the front lower part of the engine and connected with the exhaust ports of the cylinders, an auxiliary condenser being arranged on a higher level, while a pump connects the lower condensers and the water chamber. The construction is such as to cause the water to circulate through a series of tubes back to the water chamber, while the water of condensation is led back to the water chamber, forming a complete circulating system. The invention is an improvement on a former patented invention of the same inventor in that class of motors in which the water is heated in a stationary boiler and supplied to a water chamber on the motor car.

Railway Appliances.

GONDOLA CAR.—Ferdinand E. Canda, New York City. This invention provides for the use of one or more lateral rods on the exterior of each side of the car body, the ends of the rods being provided with screw threads and nuts, the anchorage of the rods being made in the ends of the side boards and through iron castings forming anchor blocks, made in such form as to be completely clamped and held in place by the side boards, thereby being rendered secure against being pulled out. This improved lateral support is wholly outside of the interior surface, and none of the available space of the car is occupied by the rods or fixtures.

Electrical.

BATTERY. — Jacob O. Brinkerhoff, Hackensack, and Milton E. Smith, Rutherford, N. J. Combined with a copper cylinder forming one of the electrodes is an exciting fluid formed of an antimonious chloride and in contact with the inner and outer surfaces of the cylinder. The inventors claim for this battery long life, high voltage, and no creeping or corroding. The exciting agent may be used in liquid or solid form and applied to one or both electrodes, in the common jar battery the electrodes extending into the antimonious chloride, while in the porous cup batteries only one electrode is immersed.

Mechanical Appliances.

BARREL HOOPING MACHINE. — Max Rosenow, Peoria, Ill. This invention provides attachments for the ordinary iron hoop driving or trussing machine, whereby the machine can be readily adapted for the driving of wooden hoops on barrels, providing also suitable means whereby the chine or head hoops can be more effectually placed on the barrel without danger of crushing or breaking them.

WOODEN HOOP LOCKS. — The same inventor has patented a simple and effective machine for cutting the locks in wooden hoops in a quick and positive manner. Combined with a revolving cutter head is a hoop-clamping device arranged at right angles to the rotation of the cutter head, the device being pivotally supported and vertically adjustable in relation to the cutters. The hoops, after having one end cut into a lock, are held by their lock cut to the forked edges of gauges, which set their uncut ends to the proper position for cutting.

OIL CUP. — Thomas McEntee, Jersey City, N. J. This is a lubricating device especially adapted for oiling the crank pin of a marine or other engine, or any moving portion of machinery requiring a constant and reliable oil feed, and where the oil is difficult to apply by the use of the ordinary cup or can. It has a needle valve for adjustment to give the required feed, and the cup is made of sufficient size to supply oil for twenty-four hours, or as long as may be desired, the quantity of oil in the cup being always indicated by a gauge tube.

PLUMB AND LEVEL. — William J. Garner and Thomas Connaughton, Latourell Falls, Oregon. This invention covers a combination device having an extensible support that can be lengthened or shortened, combined with one or more spirit levels and a plumb line and bob, the level being supported by the stock and arranged transversely of and adjacent to the bob, while a suspension device is connected with the bob and extended upwardly, being secured at a point above the level. At one edge of the stock is a spirit level and at the opposite edge is a swinging gravity level.

WATCH MAKER'S ROLLER REMOVER. —Michael L. Sheehan, New York City. This is an improved device for removing and replacing the rollers of watch balance wheel staffs or pivots, the invention providing a simple construction whereby rollers may be disengaged from the staffs or pivots of balance wheels in an expeditious and convenient manner, without disturbing the hair spring or injuring the pivots or ruby pin.

MECHANICAL MOVEMENT. — Israel F. Good, Allentown, Pa. In a suitable frame is mounted a vertical shaft having at its upper end a gear wheel, above which is secured a post supported by radial bars, a gear wheel meshing with the lower gear wheel and connected to the post by a universal joint, with other novel features, the device being designed to furnish a simple means for multiplying speed and transmitting power.

Agricultural.

CORN HARVESTER. — Thomas B. Jones, Radnor, Ohio. Combined with a gathering frame hinged to swing laterally, and having yielding means for holding it normally parallel with the rows of corn, are upper and lower endless belts carried by the frame, and a stalk-cutting mechanism below the lower belts for cutting the stalks as they pass between the belts. The stalks are held in an upright position at the time they are cut, the machine also spreading the butt of the shock prior to its delivery from the harvester.

POTATO DIGGER AND HARVESTER.—Clinton Lanker, St. Joseph, Mo. This invention consists of a plow having a double mould board and discharging on to an inclined elevator provided with raking arms traveling over the grated bottom of the elevator to carry the potatoes upward, a discharge spout being arranged transversely below the elevator. The machine gathers the potatoes, separates them from the soil and weeds, and delivers the cleaned potatoes to bags or other receptacles carried on the machine.

Miscellaneous.

BLEACHING. — Honore Korwin de Pawlowski, Paris, France. This invention provides an apparatus for the bleaching of vegetable and animal matter, and the washing and scouring of wool and other substances, either woven or yarn or fiber, with the avoidance of manipulation. Combined with a series of vats containing liquid, and connected with each other below the level of the liquid, are two vacuum receptacles, placed on a higher level than the vats and connected with them below the level of the liquid, to effect alternately an automatic displacement of the liquid in the vats.

CANE JUICE FILTRATION. — Leon Boyer, New Orleans, La. This is an improved apparatus for treating cane juice by filtration, designed to make the juice so clean that the custom of using lime to neutralize the acid in the juice can be so simplified as to require but little skill or knowledge to carry it out. The invention provides a primary strainer box or filter composed of a series of strainer drawers arranged in sets one below the other, the drawers in each set being of one mesh, but the several sets being of successively finer mesh in a downward direction.

SPRAYING DEVICE.—William J. Ruff, Quincy, Ill. This invention relates to a liquid cooling apparatus more especially designed for spraying beer and ale worts, and adapted to prevent clogging of the device by small particles of hops and other substances liable to pass with the worts to the spraying apparatus. A valve is adapted to pass into the spraying orifice, being held on an adjustable valve stem, while a piston held on the valve stem is adapted to automatically actuate the latter to remove the valve from the orifice when clogged.

MEASURING AND DRAWING INSTRUMENT.—Charles W. James, Philadelphia, Pa. Combined with a forked arm are two arms of unequal length pivoted between the members of the forked arm, the longer arm being of a length equal to that of the forked arm, while a block is adjustably secured to one of the arms. The instrument is simple and durable in construction, and can be readily manipulated to obtain or measure inside or outside angles and obtain the miters of them, or it may be used for caliper-ing, or arranged as a depth and end marking gauge, dividers, compasses, etc.

SPEAKING TUBE AND EARIPHONE. — Frederick Schluchtner, Brooklyn, N. Y. This invention provides a speaking tube having, in addition to the usual mouthpiece, a branch tube with an attached earpiece, the branch tube being located between the whistle and the mouthpiece. The whistle has an operating handle exterior to the tube, and is closed by a spring on the handle.

GOODS EXHIBITOR. — Noah E. Otto, Johnstown, Pa. A strong, compact frame, easily taken apart, carries a series of vertical rollers adapted to receive rolls of fabric, there being also combined with the frame a rack adapted to hold brooms and similar shaped articles. The invention is designed to provide a neat, compact and efficient receptacle for holding and exhibiting rolls of carpets, oilcloths and other bulky and heavy fabrics, so that they may be well displayed and easily handled.

SAVINGS RECEPTACLE. -- Charles O. Burns, New York City. This invention relates to boxes used by depositors for collecting their savings from time to time and afterward depositing them in the bank. It provides a safety receptacle in which the box has a slot for entry of the coin, and an opening and closing lid, combined with a lock controlling the lid, a catch mechanism controlling the lock, and two keys, one key being stationary for operating the catch controlling the lock, and the other a movable key to the lock itself, thereby affording increased security.

SCISSORS OR SHEARS.—Julius Langenberg, Ohligs, Germany. Combined with the pivoted blades is a spring-pressed pin protruding through one of the blades so as to impinge upon the other, whereby the two blades are pressed against each other automatically without using any hand pressure during cutting. The construction is also designed to insure the blades cutting the material during the whole cutting movement, from the point where the edges meet toward the ends.

BEE HIVE TONGS. — Crawford D. Holt, Murray, Ky. This is a novel form of tongs for handling the comb frames of bee hives, the tongs having jaws adapted to clasp the tops and sides of the frames, with means for locking the jaws in position. These tongs afford ready means of handling the frames, avoiding the necessity of putting the hands or fingers in the hives and the attendant danger of being stung by the bees.

SASH FASTENER —Charles E. Angell, Salt Lake City, Utah. This is a combined window sash lock and lift, consisting of a positive locking bolt adapted to automatically engage with bolt holes in the window frame, an attached key for operating the bolt, a pivoted thumb piece applied to the outer end of the key to operate the key and serve as a lifter, together with an adjustable dog or catch adapted to engage with the key to prevent the latter from turning to act upon the locking bolt.

THILL COUPLING. — Augustus Beale, Brooklyn, N. Y. This invention provides a shaft

© 1891 SCIENTIFIC AMERICAN, INC.

coupling designed to be simple, durable and noiseless, whereby the pole may be conveniently connected to or detached from the axle by the most inexperienced helper. It also provides a means whereby the safety straps may be readily connected with or disengaged from the pole or shaft.

LOAD BINDER. — Harry M. Bradley, Canon City, Col. A longitudinally slotted bar with teeth on opposite sides has an aperture in one end for the attachment of a rope, the bar being passed through a slot in a lever, where it is held by a pin and spring-pressed pawls, and there being a rope attached to the lever, the whole forming a simple and convenient device for binding loads upon vehicles in a quick and secure manner. The device may also be used for pulling posts, tightening wire, and as a lifting jack.

WAGON BRAKE. — John W. Herrin, Mount Vernon, Ill. This invention provides a brake which will be automatically applied to the front wheels when the vehicle to which it is attached starts down on an inclined grade, and will be automatically released when a level grade is reached or the vehicle is started up hill. The invention also provides a locking device whereby the brake may be locked either when applied or released, thus taking all strain off the draught animals.

WATERING TROUGH.—John T. Thatcher, Frankfort, Ind. This trough has an apertured end, with a valve arranged to slide past the aperture, in combination with a float hinged to the side of the trough and a rod connected with the valve at its lower end and adjustably connected with the float at its upper end. It is designed that the trough shall always be filled to a definite level, the valve and float working to effect this automatically.

STOVE. — James W. Calta, Castalia, South Dakota. This is a stove of simple and durable construction for heating and cooking purposes, and specially designed for burning hay, straw, trash and rubbish as fuel. All the heat generated is passed around four sides of an oven, and the draught is readily so arranged as to entirely avoid the puffing of the burning fuel.

OIL CAN AND LAMP FILLER.—Charles W. Proctor, Lake Forest, Ill. This is a portable device, secured on a post having a suitable base, the can having a valved outlet at its lower end connected with a delivery tube through which oil is supplied to a lamp without any waste and without the use of pumps. The device is simple and durable, and the oil flows by gravity from the can to the lamp.

NOTE.—Copies of any of the above patents will be furnished by Munn & Co., for 25 cents each. Please send name of the patentee, title of invention, and date of this paper.

SCIENTIFIC AMERICAN

BUILDING EDITION.

JUNE NUMBER.—(No. 68.)

TABLE OF CONTENTS.

1. Plate in colors of a handsome residence on Riverside Park, New York City. Floor plans and elevations. Architect Mr. Frank Freeman.
2. Colored plate illustrating a row of brick dwellings at Newark, N. J., costing about $3,000 each. Perspective elevation, floor plans, etc. E. S. Ameman, Newark, N. J., architect.
3. Engravings and floor plans of a double residence on Washington Heights, New York City. Cost $20,000 each. A very picturesque design.
4. A dwelling at New Haven, Conn. Cost $8,000 complete. Perspective view, floor plans, etc.
5. A colonial cottage erected for Mr. C. W. Macfarlane at Elm Station, Pa. Cost $5,300 complete. Floor plans and perspective view.
6. Design of a modern interior. A comfortable hall and staircase.
7. A picturesque cottage erected for George W. Childs, Esq., in his Villa Park at Wayne, Pa. Cost $7,200 complete. F. H. & W. L. Price, Philadelphia, architects. Plans and perspective.
8. A tower house recently erected at Elm Station, Pa. Cost $4,600 complete. Floor plans, perspective elevation, etc.
9. A row of low cost colonial houses erected at Roseville, N. J. Cost complete $2,000 a house. Plans and perspective view.
10. An English cottage erected at Elm Station, Pa. Cost about $4,000. Perspective and floor plans.
11. Sketch of a farm house recently built in Steuben County, New York, at a cost of $695.
12. Miscellaneous contents: Simplicity in furnishing and decoration.—Weight as a test of strength in timber.—Architect of the Woman's Building of the Columbian Exposition, Chicago.—Redwood for interiors.—The Richmond heater, illustrated. —Some new designs in radiators, illustrated.—Improved plumbing appliances, illustrated.—Bent glass.—Improved woodworking machinery, illustrated.—A strong and light lawn fence, illustrated. —The "Heatencook" range, illustrated.—The H. W. Johns liquid paints.—A new roofing metal, illustrated.

The Scientific American Architects and Builders Edition is issued monthly. $2.50 a year. Single copies, 25 cents. Forty large quarto pages, equal to about two hundred ordinary book pages; forming, practically, a large and splendid MAGAZINE OF ARCHITECTURE, richly adorned with elegant plates in colors and with fine engravings, illustrating the most interesting examples of Modern Architectural Construction and allied subjects.

The Fullness, Richness, Cheapness, and Convenience of this work have won for it the LARGEST CIRCULATION of any Architectural publication in the world. Sold by all newsdealers.

MUNN & CO., PUBLISHERS,
361 Broadway, New York.

Business and Personal.

The charge for Insertion under this head is One Dollar a line for each insertion; about eight words to a line. Advertisements must be received at publication office as early as Thursday morning to appear in the following week's issue.

I wish to buy second hand lathes, planers, drills, shapers, engines, boilers, and machinery. Must be in good order. Will pay cash. W. P. Davis, Rochester, N. Y.

Acme engine, 1 to 5 H. P. See adv. next issue.

Presses & Dies. Ferracute Mach. Co., Bridgeton, N. J.

Billings' Patent Breech-loading Single Barrel Shotgun. Billings & Spencer Co., Hartford, Conn.

Best Ice and Refrigerating Machines made by David Boyle, Chicago, Ill. 170 machines in satisfactory use.

Steam Hammers, Improved Hydraulic Jacks, and Tube Expanders. R. Dudgeon, 24 Columbia St., New York.

Screw machines, milling machines, and drill presses. The Garvin Mach. Co., Laight and Canal Sts., New York.

Tight and Slack Barrel Machinery a specialty. John Greenwood & Co., Rochester, N. Y. See illus. adv., p. 300.

Pneumatic bell outfit. Better than electricity. Send for circular. W. B. Beach, 132 Fulton St., N. Y. City.

Money provided to manufacture patented articles of superior merit. "Manufacturer," P. O. box 2584, N. Y.

For the original Bogardus Universal Eccentric Mill, Foot and Power Presses, Drills, Shears, etc., address J. S. & G. F. Simpson, 26 to 36 Rodney St., Brooklyn, N. Y.

The best book for electricians and beginners in electricity is "Experimental Science," by Geo. M. Hopkins. By mail, $4; Munn & Co., publishers, 361 Broadway, N. Y.

Wanted—An intelligent foundryman as foreman of a good sized foundry. Must thoroughly understand moulding, and handling of men, be strictly temperate, and honest. Only those who can give the best of references will be considered. This proposition is from a responsible firm. Address "L.," 21 Park Place, New York City.

☞Send for new and complete catalogue of Scientific and other Books for sale by Munn & Co., 361 Broadway, New York. Free on application.

Notes & Queries

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters, or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.

Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(3113) G. M. says: A question has come up as to whether a piece of iron dropped into water of any given depth would sink to the bottom or would find a point where its density and that of the water would be the same, and consequently remain suspended. Will you kindly answer this and give explanation, also please state the greatest depth of any well or boring in the world? A. The iron will sink to the bottom of the deepest oceans. Every solid substance that is heavier than water sinks to the bottom. The bottoms of the deep oceans are covered with gravel, sand and mud, with shells and vegetable growth of the deep seas. Fish and other living organisms are found at great depths. The pressure of the water is in proportion to the depth, but its density is but very slighty increased, as water can be but very slightly compressed under great pressures. The deepest bored well is about 5,000 feet.

(3114) A. C. R. asks: 1. Is lead a good electrical conductor? A. It has twelve times the resistance of copper. 2. Can you give me a recipe for a good cheap silver polish? A. Use whiting and alcohol. 3. Have the effects of a kaleidoscope ever been shown on the wall like a magic lantern? If so, is the apparatus difficult to make? A. The kaleidoscope can be thus used. It is described in Dolbear's "Art of Projection," $2 by mail.

(3115) M. T. F. asks for the cheapest way of making hydrogen gas. I wish to use it for a balloon in small towns where I can't find the manufactured gas. A. By treatment of iron or zinc scrap with dilute sulphuric acid. This is the usual way on a small scale. On the larger scale it may be made by passing steam over red hot iron scrap.

(3116) J. S. R. asks (1) as to the obelisk (in Central Park, New York), and also the Pyramids of Egypt. Are they not generally considered (by scientific men) a composition, and not blocks of natural stone? A. They are natural stone, not an artificial composition. 2. What was the date of publication of the first number of SCIENTIFIC AMERICAN? Was it a monthly paper, or or magazine, in its youth? A. September, 1845. It was a weekly.

(3117) W. F. B. asks how bird lime is made; it is used to trap birds. A. One receipt is to boil linseed oil until thick and viscid. There is much danger of conflagration in conducting this operation. A better way is to boil the middle bark of the holly for seven or eight hours in water, and put in a heap in a hole in the earth covered with boards or stones for some weeks, until reduced to a mucilaginous mass. It must be rubbed up in a mortar and washed until clean, and put into earthen pots.

(3118) P. B. says A and B have an argument about the motion of a clock's pendulum. A says it never stops in its forward and backward motion. B says it does, or it could not reverse. Who is right? A. B is right. The pendulum must come to a dead stop before it can change or reverse its movement. The time required for the change is very short and not within our perception to measure it.

TO INVENTORS.

An experience of forty years, and the preparation of more than one hundred thousand applications for patents at home and abroad, enable us to understand the laws and practice on both continents, and to possess unequaled facilities for procuring patents everywhere. A synopsis of the patent laws of the United States and all foreign countries may be had on application, and persons contemplating the securing of patents, either at home or abroad, are invited to write to this office for prices, which are low, in accordance with the times and our extensive facilities for conducting the business. Address MUNN & CO., office SCIENTIFIC AMERICAN, 361 Broadway, New York.

INDEX OF INVENTIONS

For which Letters Patent of the United States were Granted

June 16, 1891.

AND EACH BEARING THAT DATE.

[See note at end of list about copies of these patents.]

Advertising device, H. G. Rich 454,292
Alarm. See Burglar alarm.
Ammonia from sodium nitrate, manufacture of, Baudouin & Delort 454,108
Animal tread, J. R. Bevil 454,200
Antipyrine and iodine, compound of, E. Ostermayer 454,223
Atomizer, R. Lockwood 454,055
Axle, adjustable vehicle, D. C. Crawford 454,397
Axle journal and journal bearing, A. E. Smith 454,075
Axle setting machine, G. W. Hunter 454,213
Axles, method of and die for making crank, J. C. Shea 454,073
Bag. See Feed bag.
Bag lock, M. V. Mitchell 454,058
Barrel rolling implement, Hilton & Monahan 454,042
Barrow and truck, combined hand, Martin & Bohn 454,174
Basket, fish, C. R. White 454,241
Bathing suit, buoyant, R. Wightman, Jr 454,193
Battery. See Galvanic battery. Secondary battery.
Bean cutting machine, J. Steudle 454,388
Bearing, ball, H. Howard 454,049
Bed, folding, H. S. Hale 454,121, 454,122
Bed, spring, J. H. Brothers 454,027
Bell, W. L. Upson 454,190
Bi-telephone, E. J. P. Mercadier 454,138
Binding posts, making, E. T. Greenfield 454,430
Blinds, friction device for inside, J. B. Hartman 454,349
Boiler. See Water tube boiler.
Boiler furnace circulator, C. A. McAllister 454,140
Boiler furnace, steam, M. E. Herbert 454,350
Boiler tube scraper, H. V. Clynick 454,032
Boilers, mechanical stoker for steam, J. Proctor 454,379
Book, flat opening blank, P. W. Nelson 454,373
Book, flat opening blank, O. W. Smith 454,076
Boot drier, E. A. Jones 454,050
Boring machines, adjustable stop for, W. P. Kellogg 454,051
Box. See Electric resistance box. Letter box.
Brake. See Car brake. Wagon brake.
Brush, A. Hitt 454,046
Brush for lithographic stipple work, G. Arnold 454,321
Buckle, J. C. & A. M. Hyde 454,170
Burglar alarm, portable, C. C. Davis 454,033
Burial apparatus, C. M. Chamblin 454,331
Burner. See Fuel burner. Hydrocarbon burner. Vapor burner.
Button, J. N. Gotendorf, Jr 454,266
Canal rack, F. L. Robinson 454,185
Car brake, J. L. Owen 454,224
Car coupling, G. Bell 454,417
Car coupling, G. W. Dickey 454,427
Car coupling, A. Hackman 454,133
Car coupling, D. Hirsh 454,045
Car coupling, A. C. McCord 454,406
Car coupling, H. G. Russell 454,385
Car, electric motor, E. M. Bentley 454,021
Car, electric railway, E. M. Bentley 454,020
Car door, grain, E. A. Hill 454,212
Car for underground electric systems, motor, J. J. Miller 454,178
Car, railway, W. C. Whitner 454,099
Cars, safety guard for sleeping, N. Brown 454,202
Cars, sand box for, H. F. Parker 454,182
Cars, steam heating system for railway, J. F. McElroy 454,286
Card holder, G. K. Kelsea 454,277
Card list, J. H. Fezandie 454,265
Carding machine, hair, F. J. Mauborgne 454,175
Carrier. See Cartridge carrier.
Cart, road, M. Halfpenny 454,347
Cart, road, L. M. Smith 454,157
Cartridge carrier, L. M. R. Daudeteau 454,333
Case. See Pocket case.
Cash recorder, W. H. Thompson 454,089
Caster, furniture, H. McDonald 454,284
Caster, socket, Crean & Stone 454,257
Cattle rack, J. H. Howard 454,357
Caustic alkali, etc., manufacture of, A. Kayser 454,136
Centrifugal machine, T. Long 454,056
Centrifugal separator, H. Stauton 454,408
Centrifugal vessels, balancing, P. M. Sharples 454,072
Chain link, drive, T. Maxon 454,176
Chair. See Convertible chair. Hammock chair.
Chair, J. G. Wilson 454,100
Chair and sewing machine top, combined, M. M. Bostick 454,251
Check hook, W. F. Knowles 454,361
Chuck, drill, J. N. Skinner 454,074
Cigar bundling machine, Albert & Rathkamp 454,246
Cigarmaker's implement, T. Streat 454,084
Clock striking mechanism, G. W. Shuman 454,299
Closet. See Knockdown closet.
Clutch, friction, C. Hermann 454,435
Clutch mechanism, J. A. Dyblie 454,261
Clutching and releasing mechanism, E. C. McFarland 454,141
Coal separator and cleaner, Smith & Bishop 454,148
Cock, gas, Stafford & Hudson 454,234
Cofferdam, J. E. Robinson 454,383
Coffin cover, L. G. Kregel 454,363
Collar or cuff protector, E. J. B. Bowyer 454,201
Comb. See Curry comb.
Commode, D. H. Murphy 454,128
Compressing rolls, adjusting device for, J. G. Goldthwaite 454,402
Condenser, G. H. Simpson 454,386
Confectionery, machine for making, P. Knorpp 454,278
Convertible chair, L. Jorgensen 454,276
Corset, L. Harmon 454,167
Corsets, etc., clasp for, H. F. Wyatt 454,104
Cotton handling and cleaning apparatus, seed, R. S. Thomas *et al* 454,146
Coupling. See Car coupling. Hose coupling. Pipe coupling. Thill coupling.
Cradle, H. Weber 454,191
Crank pin, G. W. Rogers 454,229
Cultivator, W. C. De Graffenried 454,036
Current collecting device, R. M. Hunter 454,437
Curry comb, E. C. Hempel 454,269
Cutter. See Glass tube cutter.
Cycle saddle, W. A. Hance 454,431
Dental engine, W. W. Williamson 454,242
Dentures, apparatus for making, R. E. Zellers 454,415
Dentures, vulcanizing rubber, G. B. Snow 454,079
Desk and document cabinet, combination, C. E. Lucas 454,368
Dies, taps, etc., machine for cutting, A. W. Cash 454,029
Display rack or case, S. B. Calkins 454,164
Distilling apparatus, T. McGowan 454,061
Door check, J. Keene 454,360
Door hanger, L. Terry 454,304
Door mat, metal, E. R. Landon 454,439
Door spring, W. C. Smith 454,078
Draught equalizer, W. Z. Runkle 454,069
Draw bars, manufacture of, J. T. Wilson 454,101
Drier. See Boot drier.
Drill. See Rock drill.
Drying line support, J. Pagliughi *et al* 454,377
Egg beater, W. H. Dennison 454,165
Egg beater, E. Hadley 454,345
Egg beater, D. A. Wilkinson 454,194
Elastic or corded fabric, woven, W. Lapworth 454,366
Elastic washer, C. E. Swan 454,085
Electric apparatus for treating deafness, G. F. Webb 454,313
Electric conduit, tubular, E. H. Johnson 454,275
Electric current indicator, A. B. Herrick 454,270
Electric head light, Pattison & Desmond 454,184
Electric locked switch, F. Teague 454,087
Electric machine, dynamo, R. Eickemeyer 454,336
Electric motor, H. H. Blades 454,024
Electric resistance box, R. Eickemeyer, Jr 454,207
Electric switch, H. T. Clark 454,031
Electric systems, conduit for underground or subway, J. J. Miller 454,177
Electric wire subway, W. Readman 454,155
Electric wires, connector for, E. L. Nash *et al* 454,181
Electrical conductors, wall fixture for, Pieper & Watson 454,226
Electro deposition and cathode therefor, A. C. Reinfeld 454,381
Elevator controlling mechanism, W. O. Wakefield 454,095
Elevator safety device, A. Eichert 454,263
Embossing works in sheet metal, machine for, S. W. Babbitt 454,149
Enameling powders, machinery for distributing, Walters & Smith 454,312
Engine. See Dental engine. Pumping engine. Steam engine.
Engine, G. White 454,192
Engines, electric pole in gas or vapor explosive, Tremper & Eisenhuth 454,238
Engraving machine, J. C. Parmerlee 454,063
Envelope, W. E. Thomas 454,237
Exhibition rack, H. A. Buckholz 454,328
Explosive, Ward & Gregory 454,239
Extractor. See Pen extractor. Stump extractor.
Fabric. See Elastic or corded fabric.
Fabric stretching frame, S. Hough 454,134
Facing slip and label holder, T. W. Gaines, Jr 454,341
Fare register, J. W. Meaker 454,370
Feed bag, animal, G. D. Leonard 454,054
Feed water regulator, automatic, J. Thomas 454,088
Fence making machine, B. Duley 454,260
Filter, J. A. Fulton 454,340
Fire escape, A. R. Brandt 454,325
Fishing reel, P. H. Yawman 454,319
Fistula ligatures, device for applying, M. M. Brown 454,327
Flanger, rotary, E. P. Caldwell 454,110
Fog horn, W. Le Blanc 454,280
Fork. See Hay fork.
Frame. See Fabric stretching frame. Photographic printing frame.
Fruit gatherer, A. B. Anderson 454,320
Fuel burner, liquid, E. De Beauharnais 454,125
Funnel, indicating, A. Whelan 454,240
Furnace. See Boiler furnace. Heating, puddling, or boiler furnace. Hot air furnace.
Furnace, E. F. Edgar 454,037
Furnace, R. L. Walker 454,310
Galvanic battery, W. Macmillan 454,057
Game apparatus, S. M. Barnett 454,161
Game apparatus, J. D. Jackson 454,358
Game or puzzle, J. J. Erin 454,147
Gas and oil tank, J. N. Barker 454,106
Gas, apparatus for the manufacture of, J. L. Stewart 454,409
Gate, W. Brayton 454,026
Generator. See Steam generator.
Glass tube cutter, P. Smith 454,233
Governor, J. F. Kirby 454,218
Grader, road, J. A. Houser 454,048
Grain scourer, W. B. Anthony 454,159
Grapple, J. H. Dungan 454,335
Guard. See Life guard.
Gun, T. Nordenfelt 454,374
Gun cotton, making, H. S. Maxim 454,281
Gun, recoil-operated machine, A. Odkolek 454,403
Gun, spring air, M. F. Stanly 454,081
Gunner's arm rest, R. B. Sproul 454,300
Hair tonic, S. T. Fraser *et al* 454,401
Hame fastener, C. S. Ellis 454,400
Hammock chair, J. C. Bach 454,248
Ham stuffing machine, boneless, G. N. De Loriea 454,112
Hanger. See Door hanger. Picture hanger.
Harrow, W. Hetrick 454,352
Harrow and roller, combined, G. M. West 454,098
Harrow or cultivator, P. Blaker 454,324
Harrow, revolving, S. Sheets 454,188
Harvester, J. & W. Paterson 454,225
Harvester, corn, J. Wise 454,102
Hat and coat hook, C. H. Thurston 454,305
Hay fork, H. H. Wright 454,103
Heater. See Tire heater.
Heating apparatus, steam, J. F. McElroy 454,285
Heating, puddling, or boiler furnace, J. James 454,359
Hedge trimmer, R. H. Elliott 454,337
Heel shaping or compressing machine, C. W. Glidden 454,428
Hinge, S. P. Gibson 454,343
Holder. See Card holder. Jar holder. Map or chart holder. Sash holder.
Hook. See Check hook. Hat and coat hook. Snap hook. Whiffletree hook.
Hose coupling, J. F. McElroy 454,287
Hose or other pipes, device for stopping leakage in, J. Lawrence 454,279
Hot air furnace, J. Evans 454,264
Hot air register, T. G. Wanless 454,096
Hydrocarbon burner, C. E. Cookerly 454,332
Incrustation preventive, J. F. Stephenson 454,083
Indicator. See Electric current indicator.
Inhaler, C. A. Simpson 454,142
Inkstand, J. A. Macmeikan 454,173
Insecticide distributer, H. Myers 454,117
Insulated electric conductor, E. D. McCracken 454,060
Interfering straps, rubber pad for, M. Haughey 454,210
Iron, melting, H. J. Graf 454,209
Jack. See Lifting jack.
Jar holder, fruit, O. R. Cooke 454,396
Journal bearings, composition for, P. H. Holmes 454,354
Key fastener, W. Bishman 454,419
Knife for turning irregular forms, T. W. Gardiner 454,041
Knitting machines, needle cylinder for, E. R. Branson 454,163
Knockdown closet, H. Pattberg 454,123
Lace fastener, shoe, W. Wellock 454,314
Lacing hooks, machine for setting, W. Halkyard 454,114
Lamp, Argand, Atwood & Tobey 454,247
Lamp, blow, G. E. Moody 454,139
Lamp controller, incandescent electric, J. J. Fanning 454,038
Lamp, electric arc, P. Clarke 454,253
Lamp, electric arc, J. E. McAuley 454,443
Lamp, electric arc, S. W. Rushmore 454,294, 454,295
Lamp filament, incandescent, T. A. Edison 454,262
Lamp fixture, suspension, J. E. Bohner 454,420
Lamps, mast arm for electric, T. Dillon 454,166
Lantern, vehicle, T. B. Jefferey 454,171
Latch, C. Koegel 454,053
Lawn sprinkler, I. W. McGaffey 454,288
Letter box, E. Franke 454,127
Letter box, W. Shempp 454,298
Letter feeding and separating apparatus, G. W. Hey 454,405
Life guard, T. L. Johnson 454,214
Lifting jack, L. Meeker 454,441
Lifting jack, Sutphen & Bray 454,302
Light. See Electric head light. Ship's side light.
Liniment, B. E. Donham 454,334
Lithmetalography, C. L. Kling 454,438
Lock. See Bag lock. Nut lock.
Lock, W. C. Smith 454,077
Loom for weaving tufted pile fabrics, H. Wyman 454,414
Loom shedding and shuttle box operating mechanism, G. F. Hutchins 454,135
Loom shedding mechanism, J. Cashman 454,252
Loom, terry, F. Leake 454,367
Lumber for veneers, etc., compound, F. Koskul 454,362
Mail bag catcher, H. & C. Soggs 454,387
Map or chart holder, adjustable, A. L. Eilar 454,126
Mat. See Door mat.
Matrix making machines, type die for, C. L. Redfield 454,066
Meat tenderer, O. L. Cady 454,330
Metal slitting machines, scrap cutter for, A. P. Hine 454,353
Metals from quartz or other gangue, liquid for separating, J. S. Lurie 454,116
Milk, vessel for sterilizing and transporting, Gronwald & Oehlmann 454,267
Mine shafts, electric signal for, F. W. Bacorn 454,018
Miter cramp, D. Foster 454,039
Mop wringer, A. M. Burnham 454,203
Motor. See Electric motor.
Necktie fastener, J. Walter 454,311
Nets, machine for making, W. J. Hooper *et al* 454,355
Nut for securing pinions on shafts, differential, N. C. Bassett 454,019
Nut lock, M. Kroell 454,364
Oil for general painting, J. C. Decker 454,035
Ore sampling device, D. W. Brunton 454,120
Ores, grading and concentrating, H. Scovell 454,071
Overshoe, W. H. Sprague 454,143
Packing, piston rod, G. W. Rogers 454,384
Packing, rod, Udstad & Ryan 454,033
Painter's overshoe, A. S. Olson 454,375
Paper calendering rolls, A. S. Bacon 454,322
Paper fixture, toilet, S. Wheeler 454,317
Paper roll, wrapping and toilet, S. Wheeler 454,316
Paper shells, machine for making, G. B. Farrington 454,113
Paper tube winding machine, M. C. Stone 454,145
Pawl and ratchet mechanism, J. M. W. Long 454,440
Pen attachment, writing, D. Lubin 454,221
Pen extractor, F. C. Pfeiffer 454,064
Pen, ruling, H. H. Love 454,220
Photographic printing frame, adjustable, H. B. Hennemann 454,433
Pianoforte, G. Caddick 454,204
Picker. See Slate picker.

© 1891 SCIENTIFIC AMERICAN, INC.

Picture hanger, J. F. Coupe 454,111
Piling, making tight joints in sheet, J. E. Robinson 454,382
Pin. See Crank pin. Scarf pin.
Pipe coupling, G. Westinghouse, Jr. 454,129
Pipes, stop box for water or gas, E. G. Crawford .. 454,388
Planter, J. A. Handeland 454,348
Planter, T. C. Patterson 454,183
Planter, corn, J. R. Payne 454,378
Planter, seed, E. S. Keeler 454,216, 454,217
Planters, check row attachment for corn, C. S. Bean 454,150
Plow, steam gang, N. L. Darling 454,206
Pocket case, F. C. Avery 454,160
Printers' forms, lock-up mechanism for, Horning & Clapp 454,047
Printers' leads, machine for shaving, Damon & Peets 454,153
Printing from collotype or photo-gelatine plates, machine for, W. C. Hawkins 454,268
Printing presses, perforating attachment for, G. H. Slocum 454,231
Printing presses, perforating attachment for, Slocum & Gamble 454,232
Propeller, D. W. Horton 454,272
Propulsion of vessels, hydraulic, Bowring & Newcomb 454,151
Protector. See Collar or cuff protector.
Pulley, split, D. G. Reitz 454,227
Pulleys, universal joint and support for, T. S. Brown 454,422
Pump, W. McLennan 454,180
Pump, steam vacuum, G. E. Nye 454,062
Pumping engine, direct-acting, Mumford & Anthony 454,059
Punch, check, R. L. Rogers 454,156
Quarter-beating machine, C. W. Glidden 454,429
Rack. See Canal rack. Cattle rack. Display rack. Exhibition rack.
Rack attachment for theater or other chairs or seats, G. Hermann 454,351
Railway and vehicle for railway transportation, E. G. Tobey 454,306, 454,307
Railway, electric, F. O. Blackwell 454,023
Railway grip, cable, J. C. H. Stut 454,295
Railway, pneumatic, H. W. Wiley 454,318
Railway switch, R. Paskel 454,290
Railways, conduit for electric, E. M. Bentley 454,022
Railways, electric block system for, A. H. R. Guiley 454,344
Rails, machine for making point, E. H. Johnston. 454,274
Recorder. See Cash recorder, Speed recorder.
Reel. See Fishing reel.
Register. See Fare register. Hot air register.
Regulator. See Feed water regulator.
Reversing gear, C. Hermann 454,434
Riveting machine, M. Arnold 454,199
Rock drill, E. A. Rix 454,228
Rolling mills, girder rail roll for, Wood & Watson 454,244
Rubber goods, production of waste, N. C. Mitchell 454,442
Saddle, riding, D. Heermance 454,211
Safes, etc., making shells or casings for, J. Baum. 454,162
Safety switch, automatic, G. M. Howe 454,169
Sash holder, J. Blocher 454,025
Sawing machine, hand, Troeger & Schneider 454,308
Sawing machine turntable, J. A. Campbell 454,426
Scale for railway cars, hydraulic weighing, C. R. Bache 454,249
Scale, spring weighing, P. Kiltz 454,052
Scalping machine, J. Pye 454,065
Scarf pin, Z. Rabby 454,380
Scourer. See Grain scourer.
Screw thread cutting machine, E. & H. L. Ament. 454,197
Seamer, roofing, O. P. Talley 454,303
Secondary battery, J. S. Sellon 454,187
Secondary battery, Tommasi & Theryc 454,091
Seeding machine, R. D. Berry 454,418
Seeding machine, broadcast, V. Swanfeldt 454,158
Separator. See Centrifugal separator. Coal separator.
Sewing carpets, apparatus for, F. Ames 454,404
Sewing machine binding attachment, H. H. Barnard 454,250
Sewing machine feeding mechanism, C. M. Hine, 454,043, 454,044
Shaking screen support, W. D. Gray ..... 454,130 to 454,132
Shelving, J. L. Daniels 454,259
Shelving, portable, P. Rink 454,293
Shingles or other flat articles, device for coloring, Horton & Lee 454,356
Ship's side light, T. Andreasen 454,198
Shoe, J. W. Packard 454,376
Shot canister, J. H. Reid 454,124
Shutter worker, A. Merz 454,371
Sieve and mixer, combined, A. M. Binau 454,323
Sign, price card, etc., C. H. Buxton 454,424
Signal indicating apparatus, J. O. Ziegler 454,245
Skate, J. D. Freese 454,040
Slate picker, Bartl & Bowman 454,393
Snap hook, W. R. Davis 454,034
Snow plow flanger, E. P. Caldwell 454,109
Soda alum, making, F. M. Spence *et al* 454,189
Sodium aluminate, making, A. Kayser 454,137
Sole beating-out machine, Cutcheon & Johnson .. 454,258
Speaking tube, H. A. Cutmore 454,399
Speed recorder and register, E. Verstraete 454,391
Spinning and twisting machines, spindle support for, T. Mayor 454,282
Spring. See Door spring.
Sprinkler. See Lawn sprinkler.
Stamps, approval sheet for, R. F. Albrecht 454,416
Steam engine, O. Tackman 454,086
Steam generator, J. I. Thornycroft 454,390
Steamboat smokestack, J. B. Brolaski 454,326
Stitching and barring machine, buttonhole, J. H. Reed 454,067, 454,068
Stone, artificial, G. E. Hagerman 454,346
Stove polish, Sargent & Gallup 454,296
Street sweeper, W. H. Sterling 454,144
Striking machine, coin-controlled, H. Cooper 454,256
Stump extractor, C. E. Bassett 454,107
Supporter. See Surgical foot supporter.
Surgical foot supporter, A. G. Gefvert 454,342
Suspensory bandage, T. W. Heinemann 454,168
Switch. See Electric switch. Electric locked switch. Railway switch. Safety switch.
Tag and parcel tier, W. H. Anderson 454,105
Tank. See Gas and oil tank.
Telegraphic apparatus, electric, S. V. Essick 454,338
Thill coupling, A. Burger 454,329
Thill coupling, D. E. Russell 454,118
Thill coupling, C. Tahash 454,236
Thill coupling, H. L. Witham 454,243
Thrasher, E. F. Sanford 454,230
Thrashing machines, grain pan for, F. F. Landis .. 454,365
Tire heater, N. H. Cook 454,205
Tire rubber, J. A. Turner 454,092
Tire, wheel, T. B. Jeffery 454,115
Tobacco, hanging, F. R. Warren 454,097
Tool, combination, S. G. Arnold 454,017
Tooth, artificial, T. H. Schmitz 454,297
Toy, M. Cohn 454,254
Toy, C. A. Mable 454,369
Traction roads, rail and road bed for, J. J. Miller.. 454,179
Transformer, E. Thomson 454,090
Traps, method of and apparatus for making lead pipe S. W. W. Rosenfield 454,186
Trimmer. See Hedge trimmer.
Triturating straw, etc., for cattle, apparatus for, L. Vigreux 454,094
Trousers, M. Falk 454,208
Truck, car, C. W. Hunt 454,273
Truss, M. R. Fletcher 454,339
Tube. See Speaking tube.
Tube forming machine, seamless, E. W. Clark 454,030
Typewriting machine, C. Spiro 454,080
Typewriting machines, type holding device for, C. L. Hibbard 454,271
Umbrella attachment, H. Blassberg 454,395
Valve gear, A. M. Sykes 454,411
Valve, governor, F. N. Burt 454,423
Valve mechanism for hydraulic elevators, A. Sundh 454,410
Vapor burner, W. A. Schaner 454,119
Velocipede, R. Schweers 454,070
Velocipede saddle, T. B. Jeffery 454,172
Vending apparatus, W. Cahoon, Jr. 454,425
Vending machine, F. W. Silkman 454,407
Vending machine, newspaper, Starr & Hollingsworth 454,301
Ventilating railway and other carriages, apparatus for, J. Anderson 454,392
Ventilator, P. Abrahamson 454,195
Veterinary file, F. K. Hesse 454,436
Wagon brake, N. E. Thompson 454,389
Washer. See Elastic washer.
Washer, A. F. W. Partz 454,289
Washing compound, W. G. Eckstein 454,154
Washing machine, J. W. Butler 454,028
Washing machine, M. Van Auken 454,309
Watch cases, etc., machine for ornamenting, C. F. Morrill 454,283
Watch, repeating, E. Perrin 454,291
Water tube boiler, J. B. Johnston 454,215
Weather strip for car doors, J. W. Brown 454,421
Weighing beam, H. G. Beuckmann 454,394
Well sinking tool, J. D. Stephenson 454,082
Wells, means for and method of blowing off fluids from oil or gas, J. Heed 454,432
Wheel, D. S. West 454,315
Whiffletree hook, L. E. Waterman 454,413
Whiting, composition of matter for, G. A. Cassellman 454,152
Windmill, J. Q. Adams 454,196
Windmill, R. Monday 454,372
Windmill, power, C. O. Sylvester 454,412
Wrench, H. H. Love 454,219
Wrench, J. A. Miller 454,222
Wringer. See Mop wringer.
Yarn dressing machines, tension device for, T. H. Connor 454,255

TRADE MARKS.

Aerated spring water and ginger ale, L. T. Foss 19,731
Ale and porter, Ind, Coope & Co 19,718
Baking powder, Star Manufacturing Company 19,735
Belting, Boston Woven Hose Company 19,695
Billiard cloth, Peltzer & Son 19,733
Boards made of compressed wood and straw pulp, American Straw Board Company 19,734
Boots and shoes, Brennan & White 19,694
Brushes and combs, F. A. Maurey-Deschamps 19,704
Button fasteners, J. K. Krieg & Co 19,737
Cheese, J. S. Martin & Co 19,732
Cigars, Fernandez, Corral & Co 19,697, 19,698
Cooking vessels, sheet metal, Bronson Supply Company 19,706
Corsets, Worcester Corset Company 19,707
Corsets and trimmings therefor, I. Newman & Sons 19,713
Fish, cut and boneless, S. Gorton & Co 19,720
Gloves, kid, Wertheimer & Co 19,708
Homeopathic remedies for family use, C. W. Karsner 19,711
Knit goods, such as hosiery, underwear, and athletic goods, S. P. Curtis 19,719
Leads and chalk for use in pencils and crayons, J. J. Mitchell Company 19,723
Meats, antiseptic coloring compound for use upon cured, J. Horner 19,730
Medicinal preparations, certain, A. C. Meyer 19,703
Metal polish, Johnson Brothers 19,710
Nose bags for animals, G. D. Leonard 19,712
Perfumery and soap, S. Palmer 19,721
Perfumery, dentifrice, restoratives for the hair, and soap, Scottish Drug Depot 19,714
Pills, Carter Medicine Company 19,729
Remedies for gout and rheumatism, W. Whann 19,717
Remedy for epilepsy and other nervous diseases, S. A. Richmond 19,722
Remedy for gonorrhœa, R. T. Kelleam 19,702
Ribbons, Gartner & Friedenheit 19,699
Shears, scissors, and table, pocket, and shaving cutlery, A. J. Jordan 19,701
Shoes, men's, E. T. Harvell & Co 19,709
Sirup, sodawater, W. E. Bosshard 19,728
Soap, Procter & Gamble Company 19,724, 19,725
Soap, family, N. K. Fairbank & Company 19,696
Soldering flux, Baltimore Chemical Company 19,693
Spoons, forks, and tableware, solid and plated, G. E. Shaw 19,736
Tanning leather, compound for, F. E. Atteaux & Co 19,726, 19,727
Thread, cotton, C. G. Hubert 19,700
Tin plate in sheets, Beaufort Tin Plate Company 19,715, 19,716
Whisky, J. E. Pepper & Co 19,705

DESIGNS.

Bottle, W. B. Lillard 20,833
Bottle, druggist's show, F. M. Underhill 20,836
Lace pin, W. C. Finck 20,837
Padlock, J. S. Peacock 20,834
Photograph mount, G. F. E. Pearsall 20,840
Sign, Z. Marx 20,839
Spoon, etc., J. H. & W. H. Bullard 20,841
Spoon, etc., G. L. Crowell, Jr 20,842
Spoon, etc., A. F. Jackson 20,835, 20,838
Spoon, etc., F. Schwatka 20,832
Spoon, fork, etc., H. G. Peirsons 20,843
Stove, open front, L. Kahn 20,831

A printed copy of the specification and drawing of any patent in the foregoing list, or any patent in print, issued since 1863, will be furnished from this office for 25 cents. In ordering please state the name and number of the patent desired, and remit to Munn & Co., 361 Broadway, New York.

Canadian patents may now be obtained by the inventors for any of the inventions named in the foregoing list, provided they are simple, at a cost of $40 each. If complicated the cost will be a little more. For full instructions address Munn & Co., 361 Broadway, New York. Other foreign patents may also be obtained.

Advertisements.

Inside Page, each insertion - - 75 cents a line
Back Page, each insertion - - - - $1.00 a line

The above are charges per agate line—about eight words per line. This notice shows the width of the line, and is set in agate type. Engravings may head advertisements at the same rate per agate line, by measurement, as the letter press. Advertisements must be received at Publication Office as early as Thursday morning to appear in the following week's issue.

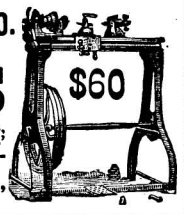
USE ADAMANT WALL PLASTER

It is **Hard, Dense, and Adhesive.** Does not *check or crack.* It is impervious to wind, water, and disease germs. It dries in a few hours. It can be applied in any kind of weather. It is in general use. Licenses granted for the mixing, using, and selling.
Address ADAMANT MFG. CO.
309 E. Genesee St., Syracuse, N. Y.

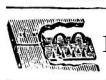
ICE-HOUSE AND COLD ROOM.—BY R. G. Hatfield. With directions for construction. Four engravings. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, **59.** Price 10 cents. To be had at this office and of all newsdealers.

"Star" Foot Lathe Swings 9x25 in.
LATHE
Screw Cutting Automatic Cross Feed, etc.
Scroll Saws, Circular Saws, Lathes Mortisers.
Catalogue Free of all our Machinery.
Seneca Falls Mfg. Co., 695 Water St., Seneca Falls, N. Y.

The Sebastian-May Co.
Improved Screw Cutting
Foot & Power **LATHES**



Drill Presses, Chucks, Drills, Dogs, and Machinists' and Amateurs' Outfits. *Lathes on trial.* Catalogues mailed on application.
165 to 167 Highland Ave., SIDNEY, OHIO.



TALCOTT'S COMBINATION PATENT BELT HOOKS,
W. O. TALCOTT, Providence, R. I.

INVENTIONS WORKED OUT. Drawings and Models made. Perfect safety to inventors assured. All kinds first-class lathe, planer, and bench work. Particular attention to special machinery, tools, dies, and press work. Safety Construction Co., 143 & 145 Elm St., N. Y.

GATES ROCK & ORE BREAKER

Capacity up to 200 tons per hour.
Has produced more ballast, road metal, and broken more ore than all other Breakers combined.
Builders of High Grade Mining Machinery.
Send for Catalogues.
GATES IRON WORKS,
50 C So. Clinton St., Chicago
215 Franklin St., Boston, Mass.

CUSHMAN CHUCKS
Complete line for all uses shown in new illustrated catalogue, *free to all.*
Cushman Chuck Co., Hartford, Conn.

"Improvement the order of the age."
THE SMITH PREMIER TYPEWRITER

Important Improvements.
All the Essential Features greatly perfected.
The Most Durable in Alignment.
Easiest Running and Most Silent.
All type cleaned in 10 seconds without soiling the hands.
The Smith Premier Typewriter Co., Syracuse, N. Y., U. S. A.
Send for Catalogue.

SPECIAL NOTICE!
Two handsome photo-engraved display sheets entitled,
"Recent Improvements in Air Compressors,"
"Recent Improvements in Rock Drills,"
mailed free to any one who will cut out this advertisement and mail it to us with his name and address.
INGERSOLL-SERGEANT DRILL CO.
No. 10 Park Place, New York, U. S. A.

ROCK DRILLS
AIR COMPRESSORS &
GENERAL MACHINERY FOR
MINING, TUNNELING, QUARRY & RAILROAD WORK.
RAND DRILL Co 23 PARK PLACE NEW YORK

ON GAS ENGINES.—A VALUABLE paper by E. Delamare-Debouteville, touching upon the history of gas motors in general, and describing in detail the "Simplex" engine invented by the author and Mr Malandin. With 23 figures. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, Nos. **715** and **716.** Price 10 cents each. To be had at this office and from all newsdealers.

Cheap Printing Do it yourself. Circular press $8. Size for small newspaper, $44. Everything easy, printed rules. Send two stamps for Catalogue to factory. **KELSEY & CO., Meriden, Conn.**

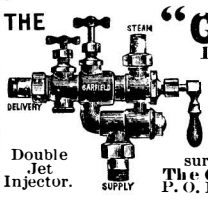
THE DAIMLER MOTOR
THE DAIMLER MOTOR CO.
is prepared to furnish **1, 2,** and **4 Horse Power**
GAS or PETROLEUM MOTORS
for all Industrial Purposes. *Fully illustrated catalogue and price list on application.* Motors in operation at Works, Steinway, Long Island City.
Office, 111 East 14th Street, New York City.

DRY AIR REFRIGERATING MACHINE. Description of Hall's improved horizontal dry air refrigerator, designed to deliver about 10,000 cubic feet of cold air per hour, when running at a speed of 100 revolutions per minute, and capable of reducing the temperature of 90° above to 50° below zero. With five figures, showing plan and side elevation of the apparatus, and diagrams illustrative of its performance. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. **288.** Price 10 cents. To be had at this office and from all newsdealers.

BARNES'
New Friction Disk Drill.
FOR LIGHT WORK.
Has these Great Advantages:
The speed can be instantly changed from 0 to 1600 without stopping or shifting belts. Power applied can be graduated to drive, with equal safety, the smallest or largest drills within its range—a wonderful economy in time and great saving in drill breakage. Send for catalogue.
W. F. & JNO. BARNES CO.,
1999 Ruby St., - Rockford, Ill.

PHOTOGRAPHY!
Our Latest Novelties for the Amateur are
KNACK CAMERAS,
MASCOT CAMERAS,
TRIAD CAMERAS,
Waterbury Detective Cameras,
Irving View Cameras, and
Magazine Cameras for Films.
THE SCOVILL & ADAMS CO.,
423 Broome Street, New York.

GYMNASTICS FOR GIRLS.—AN INteresting account of the course of instruction given at the Berkeley Athletic Club for Ladies. With 18 illustrations. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. **753.** Price 10 cents. To be had at this office and from all newsdealers.



Double Jet Injector.

THE "GARFIELD"
Locomotive Injector, Automatic Injector, Double Jet Injector and Ejector.
Best Boiler Feeders known for Hot or Cold Water Lifting or taking water under pressure. *Send for Price List.*
The Garfield Injector Co., Mfs. P. O. Box 69, WADSWORTH, OHIO.

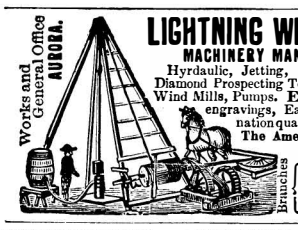
INVENTIONS PRACTICALLY DEVELOPED
Drawings, Pattern Making, Experimental and Fine Machine Work of all kinds. MILLIKEN & D'AMOUR, 151-153 Cedar Street, near West Street, New York.

COMPLETE STEAM PUMP
10 SIZES FROM $7 TO $75
FOR WATER SUPPLY TANKS, FIRE PUMPS & ETC.
WRITE FOR PRICES AND DESCRIPTIVE CIRCULARS
VAN DUZEN & TIFT
SOLE MAKERS
CINCINNATI, O.

ELECTRICAL!
Agents wanted for Fine Electrical Supplies of every description. New plate catalogue and price list on receipt of 25 cents. Discounts to the trade.
NOVELTY ELECTRIC CO., 54 North 4th St., Phila., Pa.

WOODEN TANKS. FOR RAILROADS, WATER WORKS, MILLS, FARMS &c.
LARGE WATER TANKS. COMPLETE STOCK OF CYPRESS LUMBER.
PLANS & ESTIMATES A SPECIALTY.
SPECIFICATIONS FURNISHED FOR FOUNDATIONS & TOWERS.
W. E. CALDWELL & Co
No. 217 E. MAIN ST. LOUISVILLE KY.

UNION MANUFACTURING & PLATING CO.
236-238-240 Carroll Ave., Chicago, Manufacturers of
METAL SPECIALTIES FOR INVENTORS.
ALL KINDS OF PLATING.
Estimates furnished. Correspondence invited.

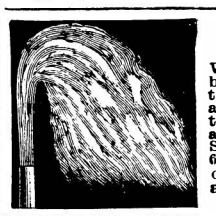


LIGHTNING WELL-SINKING MACHINERY MANUFACTURERS.
Hydraulic, Jetting, Revolving, Artesian, Diamond Prospecting Tools, Engines, Boilers, Wind Mills, Pumps. **Encyclopedia,** 1,000 engravings, Earth's Strata, Determination quality water; mailed, 25c.
The American Well Works, Aurora, Ill.
11 & 13 S. Canal St., Chicago, Ill.
Dallas, Texas.

SCIENTIFIC AMERICAN SUPPLEMENT. Any desired back number of the SCIENTIFIC AMERICAN SUPPLEMENT can be had at this office for 10 cents. Also to be had of newsdealers in all parts of the country.

OIL WELL SUPPLY CO.
91 & 92 WATER STREET,
Pittsburgh, Pa.,
Manufacturers of everything needed for
ARTESIAN WELLS
for either Gas, Oil, Water, or Mineral Tests, Boilers, Engines, Pipe, Cordage, Drilling Tools, etc.
Illustrated catalogue, price lists and discount sheets on request.

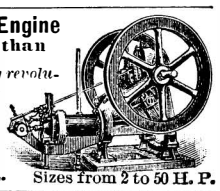
STEREOTYPING.—A VALUABLE series of lectures by Thomas Bolas, discussing the most recent methods in this branch of typography. With 23 illustrations. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, Nos. **773** and **774.** Price 10 cents each. To be had at this office and from all newsdealers.



ARTESIAN
Wells, Oil and Gas Wells, drilled by contract to any depth, from 50 to 3000 feet. We also manufacture and furnish everything required to drill and complete same. Portable Horse Power and Mounted Steam Drilling Machines for 100 to 600 ft. Send 6 cents for illustrated catalogue. **Pierce Artesian and Oil Well Supply Co.,** 80 Beaver Street, New York.

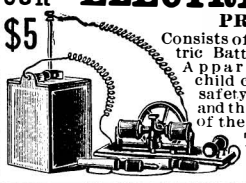
Useful Books!
Manufacturers, Agriculturists, Chemists, Engineers, Mechanics, Builders, men of leisure, and professional men, of all classes, need good books in the line of their respective callings. Our post office department permits the transmission of books through the mails at very small cost. A comprehensive catalogue of useful books by different authors, on more than fifty different subjects, has recently been published for free circulation at the office of this paper. Subjects classified with names of author. Persons desiring a copy, have only to ask for it, and it will be mailed to them. Address,
MUNN & CO., 361 Broadway, New York.

Atkinson "Cycle" Gas Engine
Uses less gas per H. P. than any other.
Has a *working* stroke at *every revolution* of the crank. The *steadiest,* most *economical,* and *easiest* to *start* of any gas engine made.
Henry Warden, Manuf'r,
1824 Allegheny Av., Phila., Pa.



Sizes from 2 to 50 H. P.

OUR "ELECTRIC PLANT"
PRICE, $5.00.
$5



Consists of an Electric Motor, Electric Battery, and Family Medical Apparatus. Entirely New. A child can handle it with perfect safety. An *Electrical Educator,* and the most scientific invention of the age. Send for circulars.
The Nowotny Electric Co.
52 East 5th Street, Cincinnati, Ohio.

The will **EUREKA INCUBATOR**
Run for 3 weeks and not vary 2 degrees. New regulator. Catalogue 5 cents. J. L. Campbell, West Elizabeth, Pa.

Truss Hoop Driving.

Barrel, Keg, Hogshead AND STAVE MACHINERY.
Over 50 varieties manufactured by
E. & B. Holmes,
BUFFALO, N. Y.
ALSO A FULL LINE OF WOOD WORKING MACHINERY.

2nd MACHINERY Lists Sent.
N. Y. Mach'y Depot, Bridge Store 16. Frankfort St., N. Y.

PATENTS!
MESSRS. MUNN & CO., in connection with the publication of the SCIENTIFIC AMERICAN, continue to examine improvements, and to act as Solicitors of Patents for Inventors.
In this line of business they have had *forty-five years' experience,* and now have *unequaled facilities* for the preparation of Patent Drawings, Specifications, and the prosecution of Applications for Patents in the United States, Canada, and Foreign Countries. Messrs. Munn & Co. also attend to the preparation of Caveats, Copyrights for Books, Labels, Reissues, Assignments, and Reports on Infringements of Patents. All business intrusted to them is done with special care and promptness, on very reasonable terms.
A pamphlet sent free of charge, on application, containing full information about Patents and how to procure them; directions concerning Labels, Copyrights, Designs, Patents, Appeals, Reissues, Infringements, Assignments, Rejected Cases. Hints on the sale of Patents, etc.
We also send, *free of charge,* a Synopsis of Foreign Patent Laws, showing the cost and method of securing Patents in all the principal countries of the world.
MUNN & CO., Solicitors of Patents,
361 Broadway, New York.
BRANCH OFFICES.—No. 622 and 624 F Street, Pacific Building, near 7th Street, Washington, D. C.

© 1891 SCIENTIFIC AMERICAN, INC.

ILLUSTRATIONS.

A

Acoustics, church ... 169
Adding machine ... 338
Administration building ... 406
Air, centifugal action ... 121
Air pump governor ... 35
Air ship, Pennington ... 150
Aluminum works, Swiss ... 355
Amalgamator, Bennett ... 294
Ampere and volt analogies ... 180
Anorthoscope ... 22
Ant eater, little ... 54
Apparatus for 1,000 ft. fall ... 114
Aqueduct, Brooklyn ... 1
Armature coils, winding ... 39
Assaying gold and silver ... 404

B

Bacillus of tuberculosis ... 7
Bag holder, Davnie's ... 354
Baling press ... 275
Banyan, an American ... 137
Barn, stock ... 386
Barrel making machine ... 376
Barrel truck, Clark's ... 386
Baseball bulletin ... 50
Bas-reliefs in cards ... 313
Bath, foot ... 162
Bath lift for the sick ... 297
Battle ship Illinois, model ... 405
Bell, electric ... 163
Belt problem ... 69
Bicycle, Diamond ... 233
Bicycle, "New Mail" ... 147
Bicycle treadle ... 115
Bicycles, Victor ... 271
Bigelow's bicycle ... 403
Bird toy ... 291
Blind hinges, Porter's ... 226
Block system, train staff ... 375
Boiler explosion ... 31
Boiler flue flanging machine ... 162
Bolt, safety ... 163
Book finishing machine ... 392
Book support, Hunter's ... 370
Brake, car, Fraser's ... 370
Bridge accident, singular ... 370
Bridge, foot, portable ... 34
Bridge, Coalbrookdale ... 371
Bridge, Hudson River, proposed ... 319
Bridges for pianos, etc ... 146
Broom holder, Allison's ... 98
Brush, window cleaning ... 162
Bulletins, electric ... 50

C

Cable grip, Dainty's ... 18
Cable railway crossing ... 195
Camera, wonder ... 217
Canal, Nicaragua ... 63
Cannon ball photography ... 38
Car brake, Fraser's ... 370
Car coupler, Marshall's ... 322
Car coupling, Stewart's ... 388
Car fire extinguisher ... 35
Car freight, platform ... 259
Car receiver, Turner's ... 354
Car replacer ... 210
Cardboard machine ... 249
Carriage spring ... 89
Carriage, steam ... 119
Cart, dumping, Libbey's ... 339
Casting Beecher statue ... 399
Casing, steam pipe ... 178
Castrography ... 313
Centenarian ... 147
Chamfering stone ... 306
Channels, deepening ... 265
Charleston, cruiser ... 358
Chinese figures ... 403
Church acoustics ... 169
Churn, McBride's ... 168
City of Paris, dredge ... 63
Clamp, flooring ... 35
Clark's engine ... 403
Clasp for timbers ... 195
Cloth pressing machine ... 247
Cock, gauge, Marfarter ... 115
Coils, armature, winding ... 39
Columbus, portrait of ... 290
Combat naval ... 359
Comptograph ... 338
Cooler for milk cans ... 291
Cotton chopper ... 57
Coupler, car, Marshall's ... 322
Coupling, car, Stewart's ... 388
Crate, knockdown, Bickel's ... 89
Croton Lake dam ... 383
Cruiser Charleston ... 358
Cut-off, rain water ... 291

D

Dam, Croton Lake ... 383
Dam, Housatonic River ... 182
Dead, electroplating ... 227
Depot, Pennsyl. Railroad ... 102
Derrick, floating, steel ... 175
Diffraction, examples ... 281
Diversions, scientific ... 27
Dog, saw mill ... 274
Drain at Khorsabad ... 194
Drawer stop ... 233
Dredge, Bennett ... 294
Dredge City of Paris ... 63
Drill for blasting ... 322
Drills, hand, driving mech ... 130
Driving device ... 98
Driving device, vehicle ... 210
Driving mech., hand drill ... 130
Driving mechanism, vehicle ... 163

E

Electric belt ... 163
Electric machine, static ... 387
Electric motor for amateurs ... 39
Electric race reports ... 102
Electric station, Edison ... 367
Electric wires in snow storm ... 86
Electroplating the dead ... 227
Elevator, water ... 153
Engine, gas, Atkinson's ... 339
Engine, rotary, Everest's ... 131
Engine, triple expansion ... 8
Engines of Puritan ... 79
Engines, triple expansion ... 118
Envelope moistener ... 233
Evaporation, apparatus for ... 342
Excavating app., aqueduct ... 1
Exhibition, Jamaica ... 131
Explosion, locomotive ... 31
Explosive, Bowman's ... 5
Express train, "Ghost" ... 223

F

Fair, world's, buildings ... 374
Fan, desk or dental motor ... 276
Feed rack, Warren's ... 386
Feet, care of ... 185
File handle, universal ... 181
Filter, water, Darragh ... 249
Fire boat, new, for New York ... 148
Fire department, Vienna ... 327
Fire extinguisher, car ... 35
Fire pail ... 5
Fish habitation ... 198
Flambeau, zinc ... 327
Flanging machine, flue ... 162
Floods, winter, Connecticut ... 182
Flooring clamp ... 35
Flying machine, pneumatic ... 167
Foot bath ... 162
Fountain, portable ... 99
Fruit press, Randall's ... 233
Furst Bismarck, steamship ... 335

G

Garden, hanging ... 295
Gas engine, Atkinson's ... 339
Gas and petroleum motor ... 82
Gauge cock, McCarter's ... 115
Gauge pressure, Eiffel tower ... 306
Gauge, water ... 355
Gear, for planers ... 54
Ginseng ... 19
Girth fastener ... 226
Glass, iridescent ... 329
Glass, magnifying, magnetic ... 25
Governor, air pump ... 35
Grate for ranges, etc ... 178
Greytown ... 63
Grinder, scissors ... 4
Grip, cable, Dainty's ... 18
Guns, heavy, manufacture ... 159
Guns, navy, manufact ... 127

H

Halter, Shippy's ... 84
Harrow and cutter, new ... 4
Hay stacker ... 179
Heater, gas burner ... 146
Heater for soft coal ... 275
Heron's solution of it ... 67
Hinges, blind, Porter's ... 226
Holdback, Ellsworth's ... 84
Horse and barn problem ... 212
Horse race on the stage ... 263

I

Illinois building at fair ... 242
Illusions, optical ... 22
Illusions, theatrical ... 259
Index, Judge's ... 146
Invention, modern and ancient ... 105
Iron gates of the Danube ... 38
Iron, pig, storage yard ... 246
Itata, steamer ... 358

J

Jackscrew, Kalbach's ... 306
Jamaica Exhibition ... 131
Journal cap, Shank's ... 5

K

Kinetograph, Edison's ... 393

L

Ladder, extension ... 327
Lake, Croton, new ... 383
Lamp, olive oil ... 135
Lamp socket, simple ... 51
Language, sign, Indian ... 23
Lantern effect, new ... 345
Lathes, attachment for ... 360
Lathes, foot, attachment ... 135
Lathes, gun ... 166
Leveler, meadow, new ... 34
Life guard for cars ... 392
Life saving service, U. S. ... 117
Liquid measuring device ... 274
Lock combination ... 179
Lock, door, Hollyday's ... 386
Lock, nut, simple ... 377
Lock, Roger's ... 178
Locomotive attachment ... 151
Locomotive explosion ... 31
Locomotive, Pike's Peak R.R. ... 47
Locomotives, St. Clair tunnel ... 391
Locomotives for Australia ... 293

M

Machinery hall ... 405
Mallies viaduct ... 15
Manometer, Eiffel tower ... 306
Marold's car brake ... 403
Mask, fire ... 327
Megascope ... 216
Metallo-chromes ... 8
Meadow leveler, new ... 34
Mica, star ... 281
Microscopic objects, gathering ... 391
Milk can cooler ... 291
Mines, nitrate of soda ... 135
Miniature electric motor ... 403
Mirror, astronomical ... 226
Model hall, Patent Office ... 243
Motor, dental, small ... 276
Motor, electric, for amateurs ... 39
Motor, gas, Atkinson's ... 339
Motor, gas and petroleum ... 82
Motor, petrol., for tricycle ... 95
Moulding Beecher statue ... 399
Mouse, animated ... 279

N

Navy, U. S., manufact. guns ... 127
Necktie, photographic ... 4
New Yorker, fire boat ... 148
Nicaragua, view of ... 72
North Wind, steamer ... 51

O

Olive oil lamp ... 135
Optical illusions ... 22
Ordnance, heavy, manufact ... 159
Ore concentrator ... 377
Ore washer, Miller's ... 326

P

Package tie, Plumer's ... 146
Pail, fire ... 5
Palanquin, magic ... 259
Park, new, for New York ... 198
Partition, fireproof ... 211
Patent centennial ... 207, 214, 215
Patent Office ... 243
Patent Office, father of ... 295
Patent system, centennial ... 259
Penholder, Richardson's ... 35
Perfume distributer ... 105
Phaeton, steam ... 119
Phonometer, Hewing's ... 169
Photography, cannon ball ... 38
Picotah, the ... 311
Picture frame hanger ... 246
Pipe cutting machine ... 151
Pipe hanger, Scott's ... 226
Pipe laying apparatus ... 1
Pipe, steam, for heating ... 54
Piston packing, Pfaum's ... 328
Platform, freight car ... 259
Plow, snow, steam ... 130
Poison of snakes ... 161
Press, baling ... 275
Press, fruit, Randall's ... 233
Press to print in colors ... 258
Pressure regulator, roller ... 114
Projectile, 10 in., turning ... 167
Projection of opaque objects ... 216
Prope ling device, Libbey's ... 210
Propelling mechanism ... 163
Pump, air, governor for ... 35
Puritan, engines of ... 79
Puritan, steamer ... 87

Q

Quilter for sewing machine ... 210

R

Race reports, electric ... 102
Railroad accident, remarkable ... 343
Railroad cable, New York ... 303
Railroad, Pennsylvania, depot ... 102
Railroad tie, etc., new ... 178
Rai road unicycle ... 191
Railway collision, Iowa ... 9
Railway crossing, cable ... 195
Railway, Pike's Peak ... 47, 55
Railway, ship, Chignecto ... 230
Railway unicycle ... 66
Rain water cut-off ... 291
Range grate ... 178
Rheostat, simple ... 51
Rifle, Mauser ... 279
Rifle range guards ... 402
Rings of Nobili ... 8
Road, cable, New York ... 303
Ruggles, John ... 295
Ruler, parallel, Forwood's ... 18

S

Safety device for roads ... 179
Sawdust feed furnaces ... 231
Scissors grinders ... 4
Sewer at Khorsabad ... 194
Shaft, big, mending ... 361
Shelving, high, device to reach ... 68
Ship railway, Chignecto ... 230
Ships, battle, new line ... 255
Singletrees, device for ... 195
Sleeper, observatory ... 274
Sleigh runner, Radley's ... 275
Smith's railroad tie ... 402
Smoke effect, lantern ... 165
Snuggling, science of ... 50
Snake violet ... 161
Snakes, poison of ... 161
Snow plow, steam ... 130
Soda, drawing from bottle ... 67
Soda nitrate, Chilian ... 135
Spark arrester, Hadlock's ... 322
Sphere, skeleton ... 121
Spindle support ... 98
Splice, long, for ropes ... 40
Spring, carriage ... 89
Steam pipe casing ... 178
Steamer Itata ... 358
Steamer North Wind ... 51
Steamer Puritan ... 87
Steamship Furst Bismarck ... 335
Stoker, mechanical ... 211
Stove grate ... 178
Swing, adjustable ... 67

T

Tappet, Nolan's ... 67
Telegraph transmitter, Smith's ... 18
Telephone, cosmical, Edison's ... 393
Telephone, Naviege's ... 98
Telephony, long distance ... 51
Tie and rail fastening ... 402
Tie, metallic, Saunder's ... 338
Tie, package, Plumer's ... 146
Tie, railroad, new ... 178
Toad fish ... 199
Tombstone, curious ... 99
Tool, dehorning ... 226
Tool holder, Nielsen's ... 211
Tool holder that holds ... 85
Top, aerial, simple ... 377
Torpedo, the Canet ... 70
Torpedoes, manipulation ... 359
Tower, great, City Hall, Phila ... 351
Tower, Proctor ... 151
Toy bird ... 291
Train, express, "Ghost" ... 223
Train staff block system ... 375
Trap, animal, Pead's ... 35
Treadle for bicycles ... 115
Trick, egg and hat ... 279
Tricycle, petroleum motor ... 95
Trolley track, step ladder ... 68
Truck, barrel, Clark's ... 386
Truss, improved ... 233
Tuberculosis, bacillus of ... 7
Typewriter, French ... 328

U

Unicycle railroad ... 191, 66

V

Valve, gate, new ... 322
Valve, safety, Kunkle's ... 163
Vase, water, lustral ... 105
Vaulting, oriental ... 194
Vehicle wheel ... 179
Velocipedes, hand lever ... 115
Velocipede, Schieding's ... 276
Vesuvius, eruption of ... 345
Viaduct, Mallies ... 15
View of lagoon ... 405
Violet, snake ... 161
Volcanic effects, apparatus ... 345

W

Walls, partition, fireproof ... 211
Water, drawing, by ancients ... 311
Water elevator, pendulum ... 153
Water gauge ... 355
Water vase, lustral ... 105
Water wavs, scouring ... 265
Well, tubular, Rice's ... 259
Wells, artesian, Dakota ... 390
Wheel, breast, Morris Canal ... 326
Wheel dresser, emery ... 354
Wheel, vehicle ... 179
Whiffletree, Allen's ... 195
Whitney, Col. N ... 147
Window cleaning brush ... 162
Wires, electric, in snow storm ... 86
Wrench, Farris' ... 210
Wrench, Ryan's ... 163

MISCELLANY.

Figures preceded by a *star* (*) refer to illustrated articles.

A

Acid, carbonic, in air ... 67
Acid, hydrazoic ... 100
Acid, oxalic, from sulphite liquor ... 199
Acid, tartaric, reaction ... 281
Acid, white ... 373
Acids, test paper for ... 20
Acoustics, church ... *169
Actors, face paints for ... 320
Adding machine ... *338
Administration building ... *406
Adulteration law, Belgian ... 196
Africa, partition of ... 217
Age, old, science of ... 104
Air, centrifugal action ... *121
Air pump governor ... *35
Air ship Pennington ... *150
Air, 300 feet in ... 281
Aluminum at Boonton ... 202
Aluminum, cheap ... 164
Aluminum manufacture ... 217
Aluminum, Newport, Ky ... 180
Aluminum overrated ... 197
Aluminum, soldering ... 53
Aluminum, use of ... 162
Aluminum, uses for ... 129
Aluminum, weight and strength ... 102
Aluminum works, Swiss ... *355
Amalgamator, Bennett ... *294
Amber ... 147
America, original work in ... 320
American copyright ... 404
Ammonia, coal, for refrigeration ... 241
Ammonia as fire extinguisher ... 160
Ammonia, production ... 40
Ammonia, synthesis ... 67
Ampere, explanation of ... 133
Ampere and volt analogies ... *180
Angina pectoris ... 400
Animal life, destruction of ... 37
Animal photography ... 181
Animals, longevity of ... 132
Animals, lower, appear. of world ... 132
Anorthoscope ... 22
Ant eater, little ... *54
Ants, bridge built by ... 185
Ants, white, in India ... 3
Anthracite fields of Penn ... 85
Apparatus for 1,000 ft. fall ... *114
Aquarium for New York city ... 164
Aqueduct, Brooklyn ... *1
Arbor day, inventor of ... 149
Architects, mistakes of ... 24
Arcturus ... 400
Armature coils, winding ... *39
Armor plates, American ... 392
Armor trial, new ... 324
Arsenites vs. insects ... 385
Artificial gold ... 400
Asbestos, mine, new ... 38
Assaying gold and silver ... *404
Association, Economic, American ... 33
Association, Electric Light ... 128
Astronomy, phenomena of ... 56
Athletics in New York ... 370
Autotomy in animals ... 312

B

Bacilli, good and bad ... 346
Bacillus of diphtheria ... 336
Bacillus of tuberculosis ... *153
Bag holder, Davnie's ... *354
Balance, electrical, novel ... 113
Baldness ... 278
Baling press ... *275
Balloon voyage to north pole ... 57
Banana flour ... 401
Bananas as food and medicine ... 357
Banyan, an American ... *137
Bareheaded, standing ... 116
Barn, stock ... *386
Barnum, P. T., dead ... 241
Barrel making machine ... *376
Barrel truck, Clark's ... *386
Base ball bulletin ... *50
Bath, foot ... *162
Bath lift for the sick ... *297
Bath and wash tub ... *146
Bathurst, torpedo boat ... *9
Batrachians, color of ... 132
Batrachus tau ... *199
Battery, dry, Meserole's ... 67
Battery for harbor defense ... 57
Battery, storage, railway ... 390
Batteries for New York city ... 150
Batteries, secondary ... 112
Battle ship Illinois, model ... *405
Battle ships, recent ... 160
Bazalgette, Sir Joseph ... 180
Beans, jumping, Mexican ... 369
Beauty as a means of health ... 273
Bears, illusion of ... 71
Beef extract ... 25
Beer drinking, evils of ... 198
Beetle, water ... 198
Belt, electric ... *163
Belt, life saving ... 40
Belt problem ... *69
Belting and Packing Co ... 67
Bennington, gun boat ... 168
Bering, not Behring ... 104
Bicycle, Diamond ... *233
Bicycle, "New Mail" ... *147
Bicycle treadle ... *115
Bicycles, Victor ... *271
Bigelow's bicycle ... *403
Birch oil, manuf. of ... 369
Bird, toy ... *291
Bituminous coal, Pennsylvania ... 402
Blackboard, to make ... 264
Blast, huge, another ... 393
Bleach from salt ... 264
Bleaching wool ... 373
Blenheim, cruiser ... 212
Blind hinges ... *226
Block system, train staff ... 375
Boat, submarine, new ... 41
Boats, canal, haulage of ... 345
Boats, canal, steam haulage ... 131
Boiler explosion ... *31
Boiler flue flanging machine ... *162
Boiler plates ... 51
Boiler, sky rocket ... 265
Boilers furnishing water ... 69
Boilers, steam, mishaps to ... 160
Bolt, safety, for latches ... *163
Bone grafting experiment ... 151
Book finishing machine ... *392
Book patent bill ... 49
Book, support, Hunter's ... *370
Bottle, glass, production ... 194
Boy, Iowa, a smart ... 167
Brake, car, Fraser's ... *370
Brain, overworked, relief ... 181
Brass, black polish on ... 101
Brass, composition of ... 31
Brass work, to color ... 291
Brick, enameling ... 339
Bridge accident, singular ... *370
Bridge built by ants ... 185
Bridge, Coalbrookdale ... *371
Bridge, foot, portable ... *34
Bridge, Hudson River, proposed ... *319
Bridge for pianos, etc ... *146
Bridge, Verrugas, completion ... 7
Bridgman, Laura, brain of ... 369
Bronze casting ... 49
Bronze, liquid ... 311
Bronze, origin of the word ... 168
Broom holder, Allison's ... *98
Brush, window cleaning ... *162
Building in America ... 229
Bulletins, sporting, electric ... *50
Butter, cocoanut ... 20
Butter, detecting ... 112
Butterflies, green ... 312

C

Cab cell, electric ... 89
Cable grip, Dainty's ... *18
Cable railway crossing ... *195
Camera, necktie ... 49
Camera obscura ... 297
Camera, wonder ... *217
Camphor, Florida ... 54
Camphor tree, domesticating ... 353
Canadian Pacific enterprise ... 390
Canal boats, haulage of ... 233, 345
Canal enterprises ... 201
Canal, Lake Union ... 240
Canal, Nicaragua ... *63
Canal, Panama, sad condition ... 38
Canal, water, large ... 20
Cannon ball, photography ... *38, 120
Car brake, Frasier's ... *370
Car coupler law of New York ... 21
Car coupler, Marshall's ... *322
Car coupling, Stewart's ... *388
Car fire extinguisher ... *35
Car, freight, platform ... *259
Car receiver ... *354
Car replacer ... *210
Car, sleeping, observatory ... 274
Car, street, electric propulsion ... 100
Cars, American, demand for ... 3
Cars, electric, run by waterfalls ... 345
Carbon cores for casting ... 40
Carbon printing, photo ... 7
Card board machine ... *249
Carriage spring ... *89
Carriage, steam ... *119
Cart, dumping, Libbey's ... *339
Casting Beecher statue ... *399
Casing, steampipe ... *178
Casting, bronze ... 49
Casting, carbon cores for ... 40
Castrography ... *313
Casts, plaster ... 133
Caterpillars, delay of train by ... 313, 355
Cavalry, too much ... 209
Celluloid, solutions of ... 151
Cellulose, solvent for ... 146
Cement for microscope slides ... 136
Cement to resist acids ... 322
Centenarian, a ... *147
Centipedes, phosphorescent ... 68, 84
Chain, West Point ... 69
Chalk, phosphatic, Englaud ... 309
Chamfering stone ... *306
Channel, Lubec, Maine ... 137
Channels, deepening ... *265
Charcoal, curative use of ... 68
Charleston, cruiser ... *358
Chicken surgery ... 37
Chimney climbing ... 281
Chinch bugs, destruction ... 313
Chinese figures ... *403
Chinese singing ... 194
Chloralamide ... 390
Cholera and snake bite ... 199
Church acoustics ... *169
Church debt, extinguishing ... 389
Churn, McBride's ... *168
City of Paris, dredge ... *63
Cities, European, growth of ... 84
Cities, large, death rates ... 99
Cities of Yucatan, ruined ... 118
Clamp, flooring ... *35
Clark's engine ... *403
Clasp for timbers ... *195
Clock, floral ... 117
Cloth pressing machine ... *247
Coal ammonia for refrigeration ... 241
Coal fields of Pennsylvania ... 85
Coal and gas as fuels ... 177
Coal tar pitch ... 242
Coal in Tonquin ... 113
Coast defense ... 341
Cock, gauge, McCarter's ... *115
Cocoanut butter ... 20
Cocoanut, taenicide prop ... 101
Coffee, imitation ... 57
Coils, armature, winding ... *39
Coincidences, premonitions, etc ... 212
College, Columbia ... 320
College, Sibley ... 55
Columbian World's Fair ... 405
Columbus, landing of ... 176
Columbus, portrait of ... 290
Combat, naval ... *359
Combustion ... 227
Commutators, filing ... 194
Compasses, magnetic rocks and ... 3
Comptograph ... *338
Concrete walls and piers ... 389
Concerts, telephone ... 130
Concord, gun boat, trial trip ... 57
Conflagrations, great, in history ... 184
Construction, monolithic ... 97
Consumption germs ... 344
Consumption, hasty, curable ... 6
Convicts in United States ... 232
Cooler for milk cans ... *291
Copper mines, greatest of ... 98
Copper production 1890 ... 69
Copper sulphate ... 195
Copper sulphate as a fungicide ... 386
Copyright bill the new ... 17
Copyrights and patents ... 260
Cork worms ... 116
Corn tassels, removing ... 165
Corrosives, pharmaceutical ... 321
Cotton chopper and cultivator ... *57
Cotton, gun ... 276
Cotton, gun, chiseling ... 81
Cotton picker, mechanical ... 39
Cotton seed oil, new use ... 20
Coupler, car, Marshall's ... *322
Coupling, car, Stewart's ... *388
Court of Appeals, Circuit ... 229
Cradina ... 264
Cramp, reply to critics ... 64
Crate, knockdown, Bickel's ... *89
Croll, Dr. James ... 113
Croton Lake dam ... *383
Crucibles, how made ... 56
Cruiser Blenheim ... 212
Cruiser Charleston ... *358
Cruiser Newark ... 2
Cruiser sunk by torpedoes ... *359
Cruiser, torpedo, Vesuvius ... 336
Cunliffe Lister ... 406
Current, alternating, dangerous ... 136
Current, electric ... 106
Currents, alternate, effects ... 344
Currents, alt. of high frequency ... 258
Curtains, lace, American ... 113
Cut worm, remedy for ... 313
Cyanides, production ... 40

D

Dam, Croton Lake ... *383
Dandruff, treatment of ... 130
Dead, electrical copies of ... 53
Dead, electroplating ... *227
Death Valley, Cal ... 98
Defense, coast ... 341
Dental pain, diagnosis ... 249
Dentures, retaining ... 291
Depot, Pennsylv. Railroad ... *102
Derrick, floating, steel ... *175
Deserts, irrigation of ... 4
Design, mechan., copying ... 209
Developers for shortly exp pl. ... 356
Differential gear, bicycle ... *403
Diffraction, examples of ... *281
Diphtheria bacillus ... 336
Diphtheria, prophylaxis of ... 18
Diphtheria, treatment ... 366
Diphtheria, treatment of ... 392

© 1891 SCIENTIFIC AMERICAN, INC.

Discovery, new, wanted 293
Diver, Cartesian, experiment.... 87
Diversions, scientific *279
Doctor who succeeds..... 261
Dog owners, warning to..... 51
Dog, saw mill..... 274
Draughtsman, good 25
Drawer stop..... *233
Drawings, to mount..... 193
Dredge, Bennett..... *294
Dredge City of Paris *63
Dredger, hopper, powerful..... 25
Drill for blasting..... *322
Drills, hand, driving mach..... *130
Driving device, Duffy's..... *98
Driving device vehicle *210
Driving mechanism for drills.... *130
Driving mechanism, vehicles.... *163
Drowning, treatment in 40
Dry goods, poisonous 375
Dynamo, great, London..... 336
Dynamos, care of..... 328
Dyspeptics, suggestions for..... 249

E

Earth, interior of..... 100
Earthquake photography..... 119
Earthworms, African 7
Economic Association, American 33
Economy of the French 150
Eczema from Virginia creeper.. 135
Education at World's Fair..... 246
Egg and hat trick..... *279
Egypt, discoveries in, recent 325
Electric belt..... *163
Electric cars, life guard for *392
Electric cars run by waterfalls... 345
Electric current 106
Electric dredger..... *294
Electric discharge phen 5
Electric effect, singular..... 34
Electric Light Association 128
Electric lighting, hydraulic..... 290
Electric machine, static *387
Electric meters, cheaper, wanted 198
Electric motor for amateurs *39
E ectric motor, work of..... 36
Electric omnibus 306
Electric phenomena, curious 387
Electric reports of races..... *102
Electric research, new..... 152
Electric ship log 262
Electric station, Edison..... *373
Electric storm..... 149
Electric transm. of power..... 209
Electric treatment of wine..... 98
Electric undergr. railw., London. 197
Electric welding..... 313
Electric welding of wheels 192
Electric wires in snow storm. *86
Electrical traction 160
Electricity, agricultural..... 65
Electricity, domestic 310
Electricity, effect on gas prop ... 386
Electricity a factor in capital ... 97
Electricity in foreign countries.. 229
Electricity in law 137
Electricty from light 168
Electricity, measure thought.... 181
Electricity, photo 289
Electricity in printing press..... 114
Electricity in railroading 296
Electricity, source and force.... 194
Electricity in tooth extraction.. 249
Electricity in war ships 358
Electricity, Wesley's..... *210
Electrics, railway, progress 310
Electroplating the dead..... *227
Elements, genesis of..... 329
Elephant, usefulness 312
Elevated places 211
Elevator, water..... *153
Employment, looking for..... 96
Employers, federation of..... 311
Empress of Japan, steamer..... 310
Enameled card glaze..... 408
Energy..... 276
Engine, gas, Atkinson's..... *339
Engine, rotary, Everest's..... *131
Engine, triple expansion *8
Engines of steamer Mackinaw.... 53
Engines, triple expansion *118
Engineer of the future 346
Engineer, steam, duties of 232
Engineers, civil, convention..... 352
Engineers, civil, society of..... 88
Engineers, electrical, inst..... 356
Engineers must study..... 193
Engineers as inventors..... 20
Engineering, steam, progress 320
Engineering work, great, India.. 81
Engraving, opaque, on glass 131
Engravings, photo, for newspapers 288
Envelope moistener *233
Epidermis, removing 260
Evaporation, apparatus for..... *342
Escape, a lucky 18
Etching, zinc..... 101
Eucalyptus for boiler scale 217
Excavating apparatus, aqueduct. *1
Exercise, indoor 160
Exhibition, Bordeaux 18
Exhibition, Chicago 321
Exhibition, Jamaica.....39, *131
Exhibits, interesting 360
Expedition, polar, another..... 368
Expeditions, polar, two..... 384
Expedition, Sierra Madre 370
Explosion, locomotive *31
Explosive, Bowman's *5
Explosive mixture..... 384
Explosives, experiments with.... 53
Explosives, in pharmacy..... 321
Express train, "Ghost"..... *229

F

Face paints, theatrical 320
Fair, Columbian 248
Fair, great, proclamation of 2
Fair World's, 1893 321
Fair, World's, buildings *374
Fair, World's, education at 246
Fair, World's, finances of 376
Fair, World's, foreign exhibits... 66
Fair World's, work done at 376
Fair, World's, preparing for..... 105
Fair, World's, progress of.....101, 144
Fair, World's, site of 225
Fair, World's, women's building. 337
Fan, desk, or dental motor..... *276
Faraday, another, wanted..... 144
Farming truck..... 280
Fat in milk 51
Feed, saw dust, furnace..... *231
Feed rack, Warren's..... *386
Feet, care of *185
Fermentation, accelerated..... 340
Ferryboat, screw, new..... 147
Fifty miles per hour 115
File handle, universal..... *181
Filing commutators 194
Filter, water, Darragh *249
Fire boat, new, for New York .. *148
Fire boat New Yorker..... 167
Fire department, Vienna..... *327
Fire extinguisher, ammonia as.. 160
Fire extinguisher for cars..... *35
Fire pail..... *5
Fire in Rome, A. D 64..... 104
Fires, great, of history..... 184
Fires, one source of..... 277
Fires, precautions against..... 36
Fires, subterranean..... 99
Fish habitation..... *199
Fish manure 152
Fish remains, Silurian 129
Fishing ground, winter..... 232
Flames, lamp, illum. power..... 150
Flanging machine, boiler flue....*162
Flaws in metal, detect 113
Floods, winter, Connecticut *182
Flooring clamp *35
Flower clock 117
Flower making, artificial. 184
Flowers, change to tubers 68
Flowers, hot house, poisoning by 100
Flying machine, Maxim's..... 368
Flying machine, pneumatic. *167
Flying machine, practicability... 289
Fog, action on plants..... 50
Food adulteration law, Belgian.. 196
Food before sleep..... 135
Foods, influence on gastric juice. 321
Foot bath..... *162
Forest congress, American..... 16
Fountain, parlor, portable *99
French, economy of the..... *150
Friction, phenomenal..... 361
Fruit press, Randall's *243
Fruits, fertilization of 309
Fuel, liquid..... 323
Fuel, liquid, to fire porcelain.... 297
Fuel of war ships..... 96
Fuel saver, patent..... 164
Fuels, coal and gas as..... 177
Fungi, grub..... 375
Fungicide, copper sulphate as.... 386
Furnace, blast, Amer. in Eng.... 245
Furniture polish..... 148
Furniture polishes..... 385
Furst Bismarck, steamship..... *335

G

Galvanometer, sensitive..... 245
Garden, hanging..... *295
Gas engine, Atkinson's..... *339
Gas holders, Glasgow, destruct.. 181
Gas, natural, in England 165
Gas, natural, exhaust, of..... 2
Gas, natural, Findlay..... 53
Gas, natural, Kentucky..... 289
Gas and petroleum motor..... *82
Gas pipes, something about..... 323
Gas properties and electricity.... 386
Gas and smoke helmet 322
Gauge cock, McCarter's..... *115
Gauge, pressure, Eiffel tower.... *306
Gauge, pressure, siphon 183
Gauge, water..... *355
Gear, driving, for planers *54
Geological Society of America.. 16
Ginseng..... *19, 69
Ginseng, Chinese taxes on..... 309
Girth fastener..... *226
Glacial period, age of 358
Glass bottles, cutting 341
Glass, crystalline 148
Glass, cutting..... 292
Glass engraving, opaque..... 131
Glass, ground, to produce 356
Glass, how to cut..... 245
Glass, iridescence of..... 114
Glass, iridescent..... *329
Glass, magnifying, magnetic..... *25
Glass and metals, soldering..... 135
Glass tubes, etc., cutting. 305
Gold nugget a huge 98
Governor, air pump *35
Gramophone 177
Granite..... 324
Granite columns, how turned... 385
Granite, large mass 195
Grate areas 97
Grate for ranges, etc..... *178
Gravity, specif., of fluids..... *201
Great Republic, capacity..... 224
Greenhouses, shading..... 261
Greytown..... *63
Grinder, scissors..... *4
Grip, cable, Dainty's..... *18
Grub fungi 375
Guards for rifle ranges..... *402
Gun barrels, cleaning 388
Gunboat Concord, trial trip of... 57
Gunboat, new, trial of 168
Gun cotton..... 276
Gun cotton, chiseling..... 81
Guns, heavy, manufacture..... *159
Guns of Japanese navy..... 176
Guns, navy, manufacture..... *127
Guns and projectiles..... 357
Guns, repeating, tests for..... 49
Gunnery, progress of..... 355

H

Hair, growth after death..... 371
Hair worm..... 261
Halter, Shippy's..... *84
Harrow and cutter, new..... *4
Harvester trust 7
Haulage of canal boats..... 233
Haulage, steam, of canal boats.. 131
Hay stacker..... *179
Headache, to cure..... 167
Headache from eyeache..... 68
Health, how to preserve..... 3 5
Heart sounds at distance..... 217
Heater, gas burner..... *146
Heater for soft coal..... *275
Helmet, gas and smoke..... 322
Heron, how he solved it *67
Hinges, blind, Porter's..... *226
Hints to be heeded 36
History, American, students of.. 32
Holdback, Ellsworth's *84
Homes, healthful..... 33
Homeopathy, Milton's..... 309
Horse and barn problem..... *242
Horse breeding, N. S. Wales..... 196
Horse notes 88
Horse race on the stage *263
Horse, what he would say 194
Horses, cause of death 106
Hulls, steel, lacquer for..... 184
Humming bird notes 119
Hydrogen prod. by electricity... 192

I

Ice forming under water 116
Ice harvest, Hudson River..... 80
Ice, temperature of..... 101, 178
Identity by the thumb..... 105
Illinois building at fair..... *242
Illusions, optical..... *22
Illusions, theatrical..... *259
Illustrations, copying book..... 325
Imagination tricks of..... 65
Improved car brake..... *403
Improved engine..... *403
Improvement that failed..... 392
Indebtedness, statistics of..... 371
Index, Judge's..... *146
Industry, new, Sunderland..... 99
Inflammables, dangerous..... 321
Influenza, cause of 358
Influenza, home of..... 104
Inoculation vs. yellow fever..... 121
Insane, the..... 361
Insect pierces lead pipe 368
Insect powder, toxic principle... 34
Insects, electric utilization..... 153
Insecticides, valuable..... 385
Insulator, new 115
Insulators, how made..... 388
Insurance, life 149
Invention, modern and ancient..*105
Invention, a needed 325
Invention, progress, hindrances. 257
Inventions, a contrast in..... 290
Inventions, index to..... 409
Inventions of employes 272
Inventions, recently patented..10, 26, 41, 58, 74, 90, 106, 122, 138, 154, 170, 186, 202, 218, 234, 250, 266, 282, 298, 314 330, 346, 362, 378, 394, 408
Inventions, signaling, needed 225
Inventors, chance for 181, 241
Inventors, engineers as..... 20
Inventors, faith of 260
Inventors, National Assoc. of... 297
Iridescence of glass. 114
Iron castings, strengthening. 259
Iron floating on molten iron 353
Iron gates of the Danube *38
Iron, pig, product, 1890 69
Iron, pig, stocks of *246
Iron port of the world..... 209
Iron, remarkable run..... 305
Iron, silvering..... 346
Iron, and steel, corrosion 264
Iron, wrought, cleaning. 242
Irrigation..... 352
Itata, steamer..... *358
Ivory, artificial..... 73

J

Jackscrew, Kalbach's..... 306
Jamaica Exhibition *131
Japan, population of 85
Jarrah wood 48
Jet propulsion 341, 372
Jet propulsion, departure in..... 289
Jews in U. S., statistics. 32
Johnstown disaster..... 35
Journal cap, Shank's *5

K

Kainit, use of..... 296
Kerosene emulsion..... 385
Kinetograph, Edison's..... *393
Kola..... 56
Kola nuts 74
Kovalevsky, Madam 184
Knowledge, scientif. and pract... 311

L

Lace curtains, American 113
Lacquer for ships' bottoms..... 96
Lacquer for war ships 184
Lagging for steam pipes..... 95
Lake, Croton, new..... *383
Lake soda..... 120
Lake Superior water power..... 113
Lakes, great, traffic of 227
Lamp flames, illum. power..... 150
Lamp, incandescent, suit..... 356
Lamp, olive oil *135
Lamp socket and rheostat..... *51
Lamps, improved, needed..... 21
Lamps, incandescent, life of..... 194
Language, English 322
Language, sign, Indian..... *23
Lantern effect, new..... *345
Lantern slides, sketching on..... 356
Lathes, attachment for. *360
Lathes, foot attachment..... *135
Launches, fast..... *226
Law, car coupler, of New York .. 21
Laziness vs. originality 6
Lead production 1890..... 69
Leap year..... 212
Lenses, microscope, improved .. 345
Lenses, spectacles, in photog 304
Letters, illicit opening of 325
Letters, sorting at sea 181
Leveler, meadow, Thompson's... 390
Library, nickel-in-slot..... 390
Lichens, ruin of..... 112
Lichens, winter life of..... 132
Life, animal, destruction 37
Life guard for cars..... *392
Life insurance..... 149
Life saving service, U. S..... *117
Light, direct production..... 118
Light, where does it go..... 265
Lighting, water power..... 323
Lighting, electric, hydraulic..... 290
Lightning bolt, E. M. F. of..... 128
Lightning, stroke of 241
Lime and limestone..... 377
Lime sulphate..... 389
Liquid measuring device..... *274
Liquor dealers, number of..... 112
Lock, an ancient..... 308
Lock, combination *179
Lock, door, Hollyday's..... *386
Lock, nut, simple..... *377
Lock, Roger's *178
Locks, U. S. mail pouch. *98
Locomotive attachment, Gross'.*151
Locomotive, breathing of..... 306
Locomotive explosion *31
Locomotive, Pike's Peak R.R.... *47
Locomotive, resist of air to..... 118
Locomotives 357
Locomotives, Amer., for, call..... 3
Locomotives for Australia *293
Locomotives, large 275
Locomotives for St. Clair tunnel. 246
Locomotives, St. Clair tunnel.... *391
Locomotives, ten wheeled..... 217
Locusts, killed by 341
Locusts, periodical 313
Log, ship, electric..... 262
Lumber railways 129
Lumbering in California..... 329
Lung disease, terpene iodide in.. 168
Lymph, Koch's, composition..... 48
Lymph, Koch's, sale of..... 261

M

Machinery hall *405
Machinery, heavy, export..... 97
Machinists, shibboleth of..... 6
Mackinaw, engines of 53
Magnet, a great..... 18
Magnetism, experiments in 57
Magnetizations, superimposed.. 312
Magnetic, str., fast time 384
Mail pouch locks..... 98
Maine shipbuilding, 1890..... 147
Malaria, mysteries of 310
Man, young, advice to 217
Manganese, production of..... 358
Manometer, Eiffel tower..... *306
Manure, fish..... 152
Maple sugar..... 36
Maps, how to mount 193
Marold's car brake *403
Mathematics, curiosities in..... 292
Maynard, Edward, Dr..... 304
Meadow leveler, new..... *34
Megascope *216
Membrane, mucous, nasal..... 118
Memory, concerning..... 121
Men of science and the public... 137
Mercury, Russian 309
Metals, flaws in, detection 113
Metal vs. wood for ties..... 257
Metal work, soap for 292
Metallic tie and rail fastening .. *402
Metals, cracks in 52
Metals, precious, mined in 1890 . 115
Meters, electric, cheaper wanted 198
Metals forged by electricity..... 393
Meters, water..... 352
Metallo-chromes..... *8
Meteorites, origin of..... 388
Mica, star *281
Microbe of rheumatism..... 152
Microscope lenses, improved... 345
Microscopic objects, gathering.. *391
Milk can cooler..... *291
Milk of Egyptian buffalo 199
Milk, fat in..... 51
Mines, nitrate of soda *135
Miniature electric motor..... *403
Mining in Rocky Mt. States..... 231
Mirror, astronomical *226
Molecules, magnetized..... 24
Monitors, hydraulic..... 308
Monolithic construction..... 97
Monuments, Chaldean, Lond..... 195
Moon..... 344
Moss, swamp..... 183
Motion, perpetual, machines..... 328
Motor, dental, small..... *276
Motor, electric, for amateurs..... *39
Motor, electric, work of 36
Motor, gas, Atkinson's..... *339
Motor, gas and petroleum..... *82
Motor, petrol., for tricycle..... *95
Moulding Beecher statue..... *399
Mouse, animated..... *279
Mushet, Robert..... 152
Muskrat, breathing under water. 132

N

Natural history notes.....68, 132, 312
Naval information, interesting.. 144
Navigation, steam history 200
Navigation, steam on lakes..... 136
Navy to aid exposition 105
Navy, build up the 224
Navy, German..... 305
Navy, our new, speed in 240
Navy, U. S., manuf. guns..... *127
Necktie, photographic *4
Negatives devel. with eikonogen. 6
Negatives, retouching..... 356
Nero, whitewashing 261
Nests, birds', on telegraph lines. 84
Newark, cruiser..... 2
Newcomb, Prof., honors to..... 71
Newspaper pictures, how made .. 101
New Yorker, fire boat *148, 167
Niagara, fall of water..... 117
Nicaragua, bird's-eye view..... *72
North Wind, steamship *51
Nose and throat diseases 257
Notes, miscellaneous....57, 69, 76, 118, 160, 176, 209
Notes and queries, indexing..... 101
Nozzle holder wanted 277

O

Observation, value of..... 41
Observatory, Harvard, report..... 137
Observatory, Lick..... 257
Observatory, Lick, staff..... 384
Observatory, Lick, life at..... 73
Observatory, Mt. Blanc..... 145
Observatory, Smithsonian..... 401
Oil, birch, manuf..... 369
Oil, cotton seed, new use..... 20
Oil, olive detecting 112
Oil regions, wonders of 66
Oleomargarine, detecting..... 112
Olive oil lamp..... *135
Omnibus, electric..... 306
Onions, sanitary qual..... 265
Opals in Washington 97
Opt cal illusions..... *22
Orange groves, Oroville, Cal..... 33
Orbits of planets, obliquity..... 37
Ordnance, heavy, U. S. navy.....*159
Ore concentrator..... *377
Ore washer, Miller's..... *326
Oregon, riches of..... 100
Otto, Dr., death of 184
Oxygen prod. by electricity..... 192

P

Package tie, Plumer's..... *146
Pail, fire..... *5
Pain, dental, diagosis..... 249
Paine, Col. Wm. H 17
Paints, face, theatrical 320
Palladium plating 245
Pambutano..... 25
Pancreatic juice..... 338
Paper making, advance in..... 308
Paper mills of the world..... 71
Paper, test, for acids 20
Park, new, for New York..... *198
Partitions, fire proof..... *211
Paste for labels..... 55
Pasteur Institute..... 230
Patent bill, book..... 49
Patent centennial *213, 224
Patent decision, important..... 201
Patent fees, reduction..... 224
Patent law, German, modif..... 329
Patent office, changes at..... 160
Patent office, father of *295
Patent office report for 1890..... 112
Patent sharks, foreign..... 133
Patent system centennial 113
Patent system, second century of, 48, 192
Patents and copyrights..... 260
Patents, decisions relating to.... 273
Patents, power to grant..... 241
Patented, what may be..... 246
Penholder, Richardson's *35
Perfume distributer, Noble's..... *165
Perfume industry of U. S..... 180
Perkins, Loftus 376
Peru, astronom. exped. to..... 120
Petroleum, origin of..... 345
Phaeton, steam, Serpollet's..... *119
Pharmacy, dangers of..... 321
Phonometer, Herring's *169
Phosphate beds, Southern 407
Phosphorescence of diamonds . 402
Photoelectricity..... 289
Photographic notes..... 6, 85, 149, 356
Photographs in ink, to print..... 162
Photographs, road, prizes for,.... 121
Photo printing process, diazo..... 164
Photo, transfer 258
Photography, applications..... 168
Photography, animal..... 181
Photography as it was and is..... 228
Photography, cannon ball.....*38, 120
Photography, earthquake..... 119
Phthisis, acute, curability..... 6
Phylloxera, mercury cure..... 292
Physicians, negro..... 249
Picotah, the *311
Picture frame hanger..... *346
Pictures, ghost or shadow..... 248
Pictures, newspaper, how made.. 101
Piers, concrete..... 389
Pike's Peak, ascent by railway... 85
Pipe cutting machine *151
Pipe hanger..... *226
Pipe laying apparat..... *1
Pipe, lead, pierced by insects.... 368
Pipe, steam, for heating..... *54
Pipes, gas, something about..... 323
Pipes, iron, to tar..... 50
Pipes, lead, to unite 74
Pipes, steam, large, composite... 324
Pipes, steel 386
Pipes, water, crossing rivers..... 177
Pipes, water, wooden 23
Pistol packing, Pflaum's..... *338
Pitch, coal tar..... 242
Pittsburg and other cities 372
Planets, position in January..... 64
Planets, position of in March.... 129
Planets, position of in April..... 193
Planets, position of in May..... 272
Planets, position of in June..... 337
Planets, position of in July..... 401
Plants, action of fog on 50
Plants, barometric 80
Plants, parasitical..... 290
Plants, pot, stimulants..... 89
Plants, preserving..... 313
Plaster cast, to clean..... 292
Plaster casts..... 133
Platform, freight car..... *259
Plating, palladium..... 245
Plimsoll, Samuel..... 256
Plow, snow, steam..... *130
Poison of snakes..... *161
Poisonous snake, Florida 401
Poisons..... 321, 340
Pole, North, expeditions to..... 384
Polish, black, on brass..... 101
Polish, furniture..... 148
Polish for mahogany..... 343
Polishes, furniture..... 385
Polychromine 120
Population, colored, progress... 329
Population, our urban..... 288
Population of U. S. for 1890..... 99
Porcelain, firing..... 311
Potato cure..... 99
Powder, smokeless..... 21, 96
Powder, smokeless, formula..... 101
Power, transmiss. elec 209
Power, transm. by wire cables... 66
Power of water in motion 261
Powers, Deborah..... 375
Pratt, Charles..... 304
Premonitions, coincidences, etc.. 212
Press, baling..... *275
Press, fruit, Randall's..... *233
Press, printing, sextuple..... 376
Press to print in colors *258
Pressure, regulator, roller..... *114
Printing in colors, press for..... *258
Printing, photo-carbon..... 7
Printing rollers, seamless..... 357
Prints, photo., mounting..... 85
Prizes for road photos 121
Projection of opaque objects.... *216
Propeller 289
Propelling device, Libbey's..... 210
Propelling mech. for vehicles.... *163
Propulsion, jet..... 341, 372
Propulsion, jet, departure in..... 289
Publishers, interesting to the.... 276
Pump, air, governor for..... *35
Pump or injector 265
Puritan, steamer..... *87
Pyrethrum, toxic princip..... 34

Q

Quarrying, notes on..... 149
Quilter for sewing mach..... *210
Quinine substitute..... 25

R

Rabies, Pasteur's treatment..... 100
Race reports, electric..... *102
Railroad accident, remarkable. *343
Railroad cable, New York..... *303
Railroad, Pennsylvania, depot..*102
Railroad tie, etc., new..... *178
Railroad tie, metallic..... *338
Railroad trains, luxurious..... 328
Railroad, transandine..... 7
Railroad, unicycle *191
Railroading, electricity in..... 296
Railroading, fast..... 336
Rails, steel, low prices..... 117
Railway appliances..... 408
Railway, Canadian Pacific..... 390
Railway collision, Iowa..... 9
Railway crossing, cable..... *195
Railway electrics, progress..... 370
Railway, five thousand mile..... 277
Railway, gliding 336
Railway, Mantou *47
Railway, Pike's Peak *55, 85
Railway property, gigantic..... 217
Railway, ship, Chignecto..... *230
Railway, Siberian, great 95
Railway, storage battery..... 390
Railway, street, Colorado..... 3
Railway, three Americas..... 67
Railway ties, wooden 80
Railway time, fastest..... 162
Railway tracks 353
Railway train derailment..... 337
Railway, underground, London.. 197
Railway, unicycle *66
Railways, lumber 129
Railways, ship, of future..... 290
Rain conditions..... 277
Rainfall in Jamaica..... 337
Rain, production, artificial..... 288
Rain, scheme for producing..... 86
Rainwater cut-off *291
Rebuilding while afloat..... 312
Recalescence in steel and iron.... 388
Redwood forests, wonderful..... 388
Relic, literary, interesting..... 195
Remains, Egyptian, discoveries.. 325
Respirator, Kleeman's..... 322
Resin washes..... 385
Rheostat, simple..... *51
Rheumatism, microbe of..... 152
Rifle range..... *402
Ring, diamond, experiment..... 341
Rings of Nobili..... *8
Roads, good 292
Rocks, effect of heat on..... 132
Rocks, magnetic 308
Rocks, magnetic, and compasses. 3
Road, cable, New York *303
Roof, effect on draught..... 115
Room for inventions..... 402
Rubies, artificial 225
Ruggles, John..... *295
Ruler, parallel, Forwood's..... *18
Rust..... 249

S

Safety device, railway..... *179
Salt, bleach, etc, from..... 264
Sand on Columbia River 89
Sand, transport, by rivers..... 21
Sanitary science..... 357
Sap, flow of..... 53
Sault Ste. Marie..... 66
Saw for steel 309
Sawdust feed for furnaces *231
Sawdust, utilization..... 232
Saw-mill dog..... *274
Scale, eucalyptus extract for.... 217
Schiseophone..... 103
Schiseophone experiments..... 113
Schiseophone, note on..... 160
Schliemann, Dr. Henry..... 52
Schultz, Jackson S 164
Science, sanitary..... 357
Scissors grinder..... *4
Screw shafts, to fish..... 388
Screws, small propeller, the best 406
Sea barrier, novel..... 114
Sea, at bottom of..... 88
Seals, fur, Bering Sea 304
Sea ports, U. S., defenseless..... 304
Sea shores, damage, prevent..... 277
Sewage, purification of..... 371
Shaft, big, mending..... *361
Shafts, screw, to fish 388
Shells, bursting charges..... 145
Shelving, high, to reach *68
Ship railways of future..... 290
Ship of war, British, new 105
Ships, battle, new line *255
Ships' bottoms, compos. for..... 232
Ships, war, fall off in speed..... 176
Ships, war, lacquer for..... 184
Shipbuilding, Maine, 1890..... 147
Shipping subsidies in France..... 230
Shipping trade, British 84
Shoes, white finish for..... 43
Siberia, northeastern opening... 56
Sierra Madre expedition..... 370
Signals, new, for cruisers 100
Signals, night, electric..... 96
Silver, nit., stains, removal..... 6
Singletrees, device for..... *195
Skin grafting, failure in..... 153
Sky, southern, mapping 36
Slate industry, American..... 89
Sleep, a week without..... 297
Sleeper, observatory..... *274
Sleigh runner, removable..... *275
Small pox pitting, prevention..... 23
Smith's railroad tie..... *402
Smoke effect, lantern..... *165
Smoke nuisance, to abate..... 265
Smuggling, science of..... *50
Snake violet..... *161
Snakes, mortality from, India.... 103
Snakes, poison of..... *161
Snow plow, steam..... *130
Snow worms..... 116, 147
Soap for metal work..... 292
Soapstone, composition..... 116
Soapstone or talc..... 196
Society Civil Engineers..... 88
Society Geological, America..... 16
Soda, caustic, from salt..... 264
Soda, drawing, from bottle..... *67
Soda Lake 120
Soda, nitrate, Chilian..... *135
Soil, odor after rain..... 308
Solution, an easy..... 373
Spark arrester, Hadlock's..... *322
Spark, high tension 181
Speed of our war ships..... 176
Spelter production 1890..... 69
Sphere, skeleton *121
Spider and beetle, contest..... 69
Spiders, mimicry in..... 312
Spindle support, Duffy's *98
Spines, effect of light 312
Spines, production of..... 68
Spirits, distilled, consumption... 118
Splice long, for ropes..... *40
Spoons, historic..... 324
Spring, carriage..... *89
Springs, spiral, making..... 289
Stains in brick, removal..... 346
Star fishes, sense of smell..... 68
Stars, distances of 103
Steam pipe casing..... *178
Steamer, Atlantic, new..... 211
Steamer Empress of Japan..... 311
Steamer Itata *358
Steamer Puritan..... *87
Steamer, steel, launch of..... 242
Steamers, mail, Atlantic..... 40
Steaming, economic 136
Steering gear, bad, dangers of... 257
Steamship Furst Bismarck..... *335
Steamship North Wind..... *51
Steel ingots, product, 1890..... 69
Steel, masses of, strain..... 354
Stickstoffwasserstoffsaure..... 100
Stockings of human hair..... 258
Stoker, mechanical..... *211
Stokers on fast ships..... 6
Stone walling 390
Stones, quarried, large. 232
Stoppers, rubber, to bore..... 376
Storm in England..... 177
Street railways, Colorado 3
Street, width, influ. health..... 24
Sugar, how made in Cuba..... 106
Sugar items, new..... 24
Sugar, maple 36
Sulphonal, administering..... 128
Sulphonal, dangers of..... 360
Superstitions, coincidences, etc.. 212
Swindler, an ingenious..... 338
Swing, adjustable..... *67

T

Talc or soapstone..... 196
Talcum, composition of..... 116
Tallow tree in China 310
Tannin, use of in plants 69
Tannin in tea, removal..... 368
Tapeworm, remedy for..... 101
Tappet, Nolan's..... *67
Tariff, egg, beating 233
Tassels, corn, removing..... 165
Tattooing, to remove..... 273
Teeth germs in infants 36
Telegram, non-delivery, damage 310
Telegraph lines, bird's nests on .. 84
Telegraph statistics..... 89
Telegraph transmitter, Smith's. *18
Telegraphing, rapid..... 165
Telephone concerts..... 120
Telephone, cosmical, Edison's....*39
Telephone, Noviega's..... *98
Telephone patents..... 116
Telephone rates 232
Telephone, was it a..... 55, 85
Telephones, Bell & Drawbaugh.. 137
Telephones, life saving..... 245
Telephoning in French..... 291
Telephony, long distance..... *51
Telescope, Lick 225
Telescopes, next advance..... 377
Temperance, enforced..... 384
Tempering tools..... 384
Teredo 84, 266
Termes in India..... 3
Terminus, Penn. R.R..... 3
Textile industries in Maine..... 280
Thermometer, history of..... 129
Thermometers, concerning..... 104
Thread, mil imeter, cutting..... 292
Threads, spiders'..... 176
Thumb, identity by 105
Tides and the stars..... 344
Tie, metallic, Saunder's..... *338
Tie, package, Plumer's..... *146
Tie, railroad, new *178
Ties, wood vs. metal for..... 257
Ties, wooden 80
Ties, wooden vs. metallic..... 245
Timber for piles, preserv 120
Timber preservation..... 5
Timber, teredo proof..... 229
Time, fast, across Atlantic..... 384
Tin, California 280
Tin cans, old, use for..... 292
Tin plate industry, American.... 104
Tin, use of, history..... 305
Toad fish *199
Toads, poison of..... 312
Toe nails, ingrowing..... 21, 51
Tomb of St. Francis Xavier..... 229
Tombstone, carious..... *99
Tones, brown, on slides..... 149
Tool, deborning *226
Tool holder, Nielsen's..... 211
Tool holder that holds..... *85
Tools, tempering..... 384
Tooth extracting, electricity in.. 248
Top, aerial, simple..... *377
Torpedo boat Bathurst 9
Torpedo cruiser Vesuvius..... 336
Torpedo firing, Canet syst *70
Torpedo manipulation..... *359
Torpedo protections..... 355
Torpedo, Whitehead..... 374
Tower, City Hall, Phila 388
Tower, great, City Hall, Phil.... *356
Tower, Proctor..... *151
Toy bird..... *291
Traction, electrical..... 160
Trade mark case..... 297
Trade mark decision..... 211
Trade mark, generic name..... 304
Trade marks, value of..... 3 1
Train, fast, French 18
Train, Pullman, new..... *229
Train staff block system..... *375
Trains, luxurious..... 328
Trains, 50 mile an hour..... 115
Transfer, photo..... 258
Trap, animal, Pead's..... *35
Treadle for bicycles..... *115
Tree, big, California 336
Tree culture as an investment.. 325
Trees, California's, big 74
Trees and shrubs in grass..... 113
Trick, egg and hat..... 279
Tricycle, petroleum motor..... *95
Trolley track for step ladders.... *68
Truck, barrel, Clark's..... *386
Truck farming..... 280
Trusts, American..... 340
Truss, improved..... *233
Tuberculosis, bacillus of..... *7, 53
Tuberculosis, Liebreich's remov, 199, 296
Tunnel building..... 233
Tunnel, Hudson River..... 3, 178, 241
Tunnel, Irish Channel..... 180
Tunnels, rapid transit..... 49
Tunnel schemes, New York..... 52
Tunnel, St. Clair, completing..... 81
Tympanum, the *311
Type setting machines..... 201
Type writer, French..... *328

U

Ultramarine..... 241
Unicycle railroad..... *191
Unicycle railway..... 67
United States posit. in war..... 256
University, Stanford..... 275
Utopia, sinking of..... 280

V

Valley, death, famous..... 31
Valve, gate, new..... *322
Valve, safety, Kunkle's..... *163
Vase, water, lustral *105
Vaseline..... 153
Vaulting, Oriental..... *194
Vegetables, copper colorations of..... 290
Vehicle wheel..... *176
Velocipede, hand lever..... *115
Velocipede, Schieding's..... *276
Venus, spots on..... 227
Vessels, new name law..... 167
Vesuvius, torpedo cruiser..... 336
Viaduct, Malleco 21
Vianna, Joaquin C. G..... 165
View of lagoon..... *405
Violet, snake..... *161
Visit to Annam family..... *408
Volt, explanation of..... 133
Vulcanite, expansion of..... 233

W

Walling, stone..... 390
Walls, concrete..... 389
Walls, decorating..... 257
Wal s, partition, fireproof..... *211
Walls, semi-permeable, prop..... 293
War ship, British, new..... 105
War ship fuel..... 96
War ships, fail in speed..... 176
War ships, lacquer for..... 184
War vessels, Italian..... 375
Washington as a convention city 16
Watch glasses..... 375
Water..... 260
Water cress, sanitary qual..... 265
Water, deterioration of..... 116
Water diversion, damages for.... 372
Water drawing by ancients..... *311
Water elevator, pendulum..... *153
Water gauge *355
Water in motion, power of..... 261
Water pipes, wooden 23
Water power into electricity..... 184
Water power Lake Superior..... 113
Water power lighting 323
Water softening process..... 356
Water supply of New York..... 64
Water supply, New York..... *383
Water vase, lustral..... *105
Water ways, scouring..... *265
Waterand wind 377
Water works, Bombay..... 100
Waves caused by explosions..... 224
Wax, insect, Chinese 260
Wax, moulding, dentists'..... 89
Wedding electric..... 313
Weed, arrow..... 369
Welding wheels, electric..... 192
Well, American, deepest..... 323
Well, a deep 304
Well, Del Norte..... 120
Well, tubular, Rice's..... *259
Well, a whistling..... 21
Wells, artesian..... 306
Wells, artesian, Dakota..... *390
West Superior, Wis..... 361
Wheel, breast, Morris canal..... *326
Wheel dresser, emery..... *354
Wheel, vehicle..... *179
Whiffletree, Allen's..... *195
Whitney, Col. N..... *147
Will, making a, to stand..... 41
Winchell, Prof..... 145
Window cleaning brush..... *162
Wine, electric treatment..... 98
Wire, steel, set of..... 54
Wires, electric, in snow storm .. *86
Woman, an aged 306, 336
Woodpeckers, illusion of..... 71
Wood pulp 210
Wool, bleaching of 373
Wool and rags, carbonizing..... 116
Woman, a remarkable 375
Work, original in America, 208, 320
Workers, young, good words to.. 360
Workshops, cleanly and orderly.. 133
World around, for five cents..... 274
Worm, cut, remedy for..... 313
Worm, hair..... 261
Worm, snow..... 116
Worms, cork 116
Worms, snow..... 147
Wreck, blowing up a..... 167
Wrench, Chaney's..... *306
Wrench, Farris'..... *210
Wrench, Ryan's *163
Writing test, Jastrow on..... 53

Y

Yucatan, ruined cities..... 118

Z

Zeal, with more than discretion. 312
Zinc etching..... 101

© 1891 SCIENTIFIC AMERICAN, INC.

The Technical Works

—OF—

CHARLES T. DAVIS.

A Practical Treatise on the Manufacture of Bricks, Tiles, Terra-Cotta, etc.—Including Hand-Made, Dry Clay, Tempered Clay, Soft Mud, and Stiff Clay Bricks, also Front, Hand Pressed, Steam Pressed, Re-Pressed, Ornamentally Shaped and Enamelled Bricks, Drain Tiles, Straight and Curved Sewer and Water Pipes, Fire Clays, Fire Bricks, Glass Pots, Terra-Cotta, Roofing Tiles, Flooring Tiles, Art Tiles, Mosaic Plates, and Imitation of Incarsia or Inlaid Surfaces, together with Enamelling in Polychrome Colors, Composition and Application of Glazes, etc., including Full Detailed Descriptions of the Most Modern Machines, Tools, Kilns, and Kiln Roofs used. By Charles Thomas Davis. Second Edition. Thoroughly Revised. 217 engravings, 500 pages. 8vo. Price.....**$5.00**

A Treatise on Steam Boiler Incrustation, and Methods for Preventing Corrosion and the Formation of Scale.—By Charles T. Davis. Illustrated by 65 engravings. 141 pages. 8vo. Price.....**$1.50**

The Manufacture of Leather.—Being a description of all of the Processes for the Tanning, Tawing, Currying, Finishing, and Dyeing of every kind of Leather; including the various Raw Materials and the Methods for Determining their Values, the Tools, Machines, and all Details of Importance connected with an Intelligent and Profitable Prosecution of the Art, with Special Reference to the Best American Practice. By Charles Thomas Davis. Illustrated by 302 Engravings and 12 Samples or Dyed Leathers. 824 pages. 8vo. Price.....**$10.00**

The Manufacture of Paper.—Being a description of the various Processes for the Fabrication, Coloring, and Finishing of every kind of Paper, including the Different Raw Materials and the Methods for Determining their Values, the Tools, Machines, and Practical Details. By Charles Thomas Davis. Illustrated by 180 engravings. 608 pages. 8vo. Price.....**$6.00**

☞ *The above or any of our Books sent by mail, free of postage, at the publication prices, to any address in the world.*

☞ *Illustrated circulars, showing full Tables of Contents of these books, sent free and free of postage to any one who will apply.*

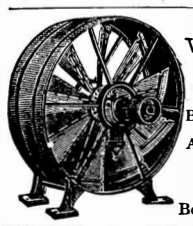
☞ *Our new and revised Catalogue of Practical and Scientific Books, 87 pages, 8vo, and our other catalogues, the whole covering every branch of Science applied to the Arts, sent free and free of postage to any one in any part of the world who will furnish us with his address.*

HENRY CAREY BAIRD & CO.,
INDUSTRIAL PUBLISHERS, BOOKSELLERS & IMPORTERS
810 Walnut St., Philadelphia, Pa., U. S. A.

"THE KRIEBEL" STEAM ENGINES.
STATIONARY, MARINE & HOISTING
ENGINES WITH VERTICAL OR HORIZONTAL
STEEL BOILERS. SEND FOR CATALOGUE
RICE & WHITACRE M'F'G. CO. CHICAGO.

THE WESTERN UNIVERSITY OF PENNSYLVANIA.

Ancient and Modern Languages, Physics, Chemistry, Geology, Civil, Mechanical, and Electrical Engineering, Astronomy (Allegheny Observatory, J. E. KEELER, late of Lick Observatory, Director). Entrance examinations for next term, Sept. 14th. $100 for best entrance examinations. "Pittsburg is the place to study engineering." For catalogue, write W. J. HOLLAND, Ph.D., D.D., Pres., PITTSBURG, PA.



CLARK'S
Ventilating and Drying
FANS.
Light Running, Adjustable Blades, Self-Oiling Bearings. 24-page catalogue free. Also Rubber Press Rolls for Wool and Yarn Washing and Dyeing Machines.
GEO. P. CLARK, Manuf.
Box L. **Windsor Locks, Ct.**

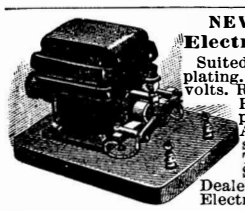
STEAM ENGINE. HOW TO MANAGE.

By J. C. S.—A very practical paper on the subject. How to fire with wood and coal, how to manage the water supply, how to clean the engine, how to clean the supply pipe, how to gauge the pump, etc. With 12 illustrations. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. **747**. Price 10 cents. To be had at this office and from all newsdealers.

The Best Mechanical Help

An inventor, investigator or experimenter can have is a great machine shop, whose business is (first) to do regular work, and (second) to help develop ideas. We have that shop, and have put what we have to say in a primer—will send it.

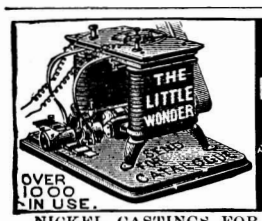
THE JONES BROTHERS ELECTRIC CO. CIN'TI, O.



NEW VICTOR, No. 0
Electroplating Dynamo
Suited for gold, silver, or nickel plating. Gives a current of 10 volts. Runs 5 gallons of solution. Price, complete, $30. Complete sets of electroplating Apparatus. Send 2-cent stamp for illus. catalogue. THOS. HALL, 19 Bromfield St., Boston, Mass., Mfr. & Dealer in all kinds of Optical, Electrical, & Chemical Supplies.

STEREOTYPING; THE PLASTER AND

Paper Processes.—Composition and preparation of the mould, the best alloys of metal and proper degree of heat, trimming and mending the plate, etc. A minute description of both processes, with numerous illustrations. A paper of great interest to every printer. By Thomas Bolas, F.C.S., F.I.C. SCIENTIFIC AMERICAN SUPPLEMENTS, **773** and **774**. 10 cents each.



NICKEL AND ELECTRO-PLATING APPARATUS & MATERIAL
THE HANSON & VAN WINKLE CO.
NEWARK, N. J.
81 LIBERTY ST. N.Y.
23 S. CANAL ST. CHICAGO

NICKEL CASTINGS FOR ALL PURPOSES.

Perfect Newspaper File

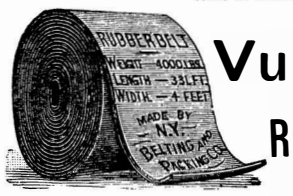
The Koch Patent File, for preserving Newspapers, Magazines, and Pamphlets, has been recently improved and price reduced. Subscribers to the SCIENTIFIC AMERICAN and SCIENTIFIC AMERICAN SUPPLEMENT can be supplied for the low price of $1.50 by mail, or $1.25 at the office of this paper. Heavy board sides; inscription "SCIENTIFIC AMERICAN" in gilt. Necessary for every one who wishes to preserve the paper. Address MUNN & CO., Publishers SCIENTIFIC AMERICAN.

DEAFNESS & HEAD NOISES CURED by Peck's Invisible Tubular Ear Cushions. Whispers heard. Successful when all remedies fail. Sold only by F. HISCOX, 853 B'way, N.Y. Write for book of proofs **FREE**

NEW YORK BELTING & PACKING CO. Limited.

JOHN H. CHEEVER, J. D. CHEEVER, F. CAZENOVE JONES, *Managers.*
WM. T. BAIRD, *Secretary.*
15 Park Row, New York.

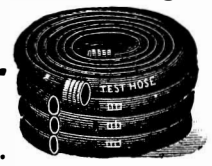
OLDEST and LARGEST Manufacturers in the United States of



Vulcanized Rubber Fabrics

For Mechanical Purposes.

Rubber Belting and Hose.



SOLID VULCANITE EMERY WHEELS.

RUBBER CUSHION BICYCLE TIRES of the most approved designs.

THE NEW MODEL "HALL."

PERFECT TYPEWRITER,
BEST MANIFOLDER.
☞ *Terms to Agents Liberal.*
PORTABLE, INEXPENSIVE.
WRITES ALL LANGUAGES.
Send for Catalogue and Specimens of Work.
Address N. TYPEWRITER CO.
611 Washington St., Boston, Mass.

The most Successful Lubricator for Loose Pulleys in use.
VAN DUZEN'S PATENT LOOSE PULLEY OILER
Highly recommended by those who have used them for the past four years. Prices very reasonable. Every user of machinery should have our "Catalogue No. 56," sent free. Mention this paper.
VAN DUZEN & TIFT, Cincinnati, Ohio.

$3 PRINTING PRESS. Do all your own printing. Save money. Catalogue for two stamps. **Kelsey & Co.,** Meriden, Conn.

STEEL TYPE FOR TYPEWRITERS

Stencils, Steel Stamps, Rubber and Metal Type Wheels, Dies, etc.
Model and Experimental Work
Small Machinery, Novelties, etc., manufactured by special contract.
New York Stencil Wks., 100 Nassau St., N.Y.

A NEW EDITION OF The Scientific American Reference Book

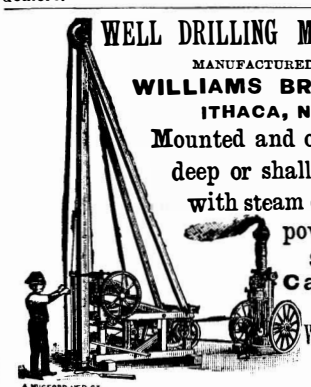
This attractive little book, of 150 pages, embraces a great variety of information useful for reference in the house and workshop. It contains the last Census of the U. S. by states and counties, and has the area of square miles in each state and territory, with tables of the occupations and the number engaged in each kind of business; lists of cities having 10,000 inhabitants; all the statistics being compiled from the 1890 census; the United States patent laws, with directions how to obtain patents, secure caveats, trade marks, design patents, and copyrights.

The book contains tables for calculating the horse power of steam engines, and other information useful and varied. The matter crowded between the covers of this little 150 page volume cannot be obtained from any other source. **Price 25 Cents.** May be had of newsmen or by mail.

MUNN & CO.
Publishers of SCIENTIFIC AMERICAN,
361 Broadway, New York.

KOCH'S DISCOVERIES.—A FULL AC-

count of Dr. Koch's remedy for tuberculosis, the method of using it, etc. With 9 illustrations. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. **782**. Price 10 cents To be had at this office and from all newsdealers.



WELL DRILLING MACHINERY.

MANUFACTURED BY
WILLIAMS BROTHERS,
ITHACA, N. Y.,
Mounted and on Sills, for deep or shallow wells, with steam or horse power.
Send for Catalogue.
ADDRESS
Williams Brothers
ITHACA, N. Y.

PEANUTS; THEIR GROWTH AND

Culture.—By J. S. Fowler. A valuable paper with 3 illustrations. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. **772**. Price 10 cents. To be had at this office and from all newsdealers.

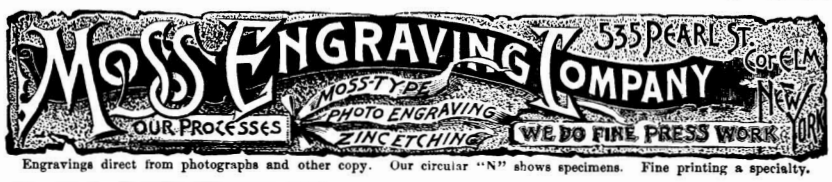
CATALOGUE FREE TO ANY ADDRESS.
MODELS AND GEARS

UNION MODEL WORKS, CHICAGO.

BLUE PRINT Paper, Superior Quality. Photographic Supplies. Send for catalogue.
T. H. McCOLLIN & CO., 1030 Arch Street, Philadelphia.

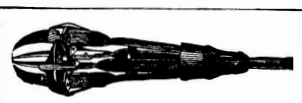
SEWING MACHINE MOTOR FOR AMA-

teurs.—By C. D. Parkhurst. Description of a very simple and effective motor, with laminated armature, of sufficient power to actuate a sewing machine. With 11 engravings. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. **759**. Price 10 cents. To be had at this office and from all newsdealers.



Engravings direct from photographs and other copy. Our circular "N" shows specimens. Fine printing a specialty.

NATIONAL STEEL TUBE CLEANER



RANKS THE HIGHEST
Endorsed by the best Engineers.
CHALMERS-SPENCE CO.
Office, 59 Liberty St., New York.

Save Money. BICYCLE
Before you buy a
Send for prices to
A. W. GUMP & CO., Dayton, O.
New Bicycles at reduced prices, and 400 second-hand ones, *Difficult Repairing.* Bicycles, Guns and Type Writers taken in exchange.
Boys' or Girls' 24-in Safety, with rubber tires, **$15.00.**
Boys' 25-inch Safety, with rubber tires - - **17.50.**
Gents' 30-inch Safety, balls to b'g's and pedals, **55.00.**

GENERAL AND EXPERIMENTAL MACHINE WORK. BEST FACILITIES IN CHICAGO. NATIONAL MACHINE WORKS, 35 S^o CANAL S^t CHICAGO ILL.

—FOR—
FREE SITES TO SUBSTANTIAL MANUFACTURING ENTERPRISES

in the rapidly growing towns of Virginia and West Virginia, possessing CHEAP IRON, CHEAP LUMBER, CHEAP FUEL, and RAILROAD FACILITIES, address J. H. DINGEE, 330 Walnut Street, Philadelphia, Pa., President and General Manager of numerous Land Companies situated along the lines of the Norfolk & Western Railroad.

AIR BRUSH Highest gold medal award by Franklin Institute as a legitimate Art Tool. Invaluable to crayon and water color portrait artists and draughtsmen. Saves time, gives finest technical effects.
AIR BRUSH MFG. CO., 67 Nassau St., Rockford, Ill.

PNEUMATIC BELL OUTFIT

Put up your own Call Bell. Nothing to get out of order. Send for Circular. W. B. BEACH, Electric and Pneumatic Supplies, 132 Fulton Street, New York City.

GASOLINE ENGINES

SMALL, BUT HUSTLERS.

A 6 x 7 inch Engine, weight 800 lbs., runs 100 feet of shafting and machinery for twenty machinists on 6 gallons of gasoline, costing only 60 cents per day. Write for particulars. Mention this paper.
VanDuzen Gas & Gasoline Engine Co
CINCINNATI, OHIO.

THE PENNA. DIAMOND DRILL & MFG. CO. BIRDSBORO, PA., Builders of High Class Steam Engines, Diamond Drilling and General Machinery. Flour Mill Rolls Ground and Grooved.

A NEW CATALOGUE OF VALUABLE PAPERS

Contained in SCIENTIFIC AMERICAN SUPPLEMENT, sent *free of charge* to any address.
MUNN & CO., 361 Broadway, New York.

BARGAINS IN NEW BICYCLES
Easy Payments, with no extra charge.

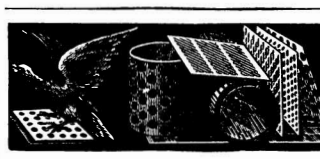
	Mfrs Price	Ours
'90 Crescent Safety, ball bear'gs	$90	$70
Mercury Diamond Safety, all steel	$100	$75
Springfield Roadster, headers imposs	$120	$70
'90 Amer. Champion, highest grade,	$100	$60

Others as cheap, all makes new or 2d hd, lowest prices Cata free. Rouse, Hazard & Co., **16** G St., Peoria, Ill.

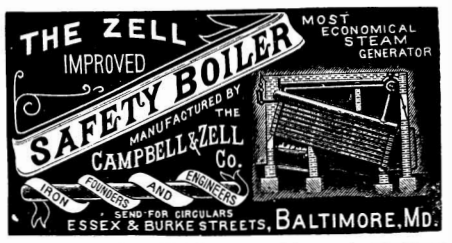
HANDY RATCHET SCREW DRIVER Double Action, POCKET size for NEW ELECTRICIANS. Tryone. Postpaid for **50 cents.** AUGUSTA MACHINE WKS., Augusta, Me.

ROCK BREAKERS AND ORE CRUSHERS

We manufacture and supply at short notice and lowest rates, Stone and Ore Crushers, containing the invention described in Letters Patent issued to Eli W. Blake, June 15, 1858, together with NEW AND VALUABLE IMPROVEMENTS, for which Letters Patent were granted May 11th and July 20th, 1880, to Mr. S. L. Marsden. All Crushers supplied by us are constructed under these patents.
FARREL FOUNDRY & MACHINE CO., Manufacturers ANSONIA, CONN.
COPELAND & BACON, Agents, NEW YORK and PHILADELPHIA.



PERFORATED METALS for MINING SCREENS,
COAL AND ORE SEPARATORS, REVOLVING AND SHAKING SCREENS,
JIGS & STAMP BATTERIES FOR ALL KINDS OF MILLING & MINING MACHINERY, & ALL OTHER
HARRINGTON & KING PERFORATING CO., CHICAGO.
NEW YORK OFFICE, 284 PEARL STREET.


THE ZELL IMPROVED
SAFETY BOILER
MOST ECONOMICAL STEAM GENERATOR
MANUFACTURED BY THE CAMPBELL & ZELL CO.
IRON FOUNDERS AND ENGINEERS
SEND FOR CIRCULARS
ESSEX & BURKE STREETS, BALTIMORE, MD.

PROPOSALS.

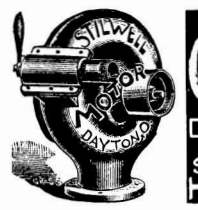
U. S. Engineer Office, ARMY BUILDING, New York, May 23, 1891.—Sealed proposals, in triplicate, will be received at this office until 12 o'clock, noon, June 24, 1891, for the construction and delivery of one Iron Roof Truss for Torpedo Shed at Sandy Hook, N. J. The attention of bidders is invited to Acts of Congress approved February 26, 1885, and February 23, 1887, Vol. 23, page 332, and Vol. 24, page 414, Statutes at Large. For specifications, blank forms, and all information, apply to the undersigned.
G. L. GILLESPIE, *Lieut.-Col. of Engineers.*

Experimental Science

BY
Geo. M. Hopkins.

Interesting Experiments in Every Branch of Physics. Descriptions of Simple and Efficient Apparatus, much of which may be Made at Home. Among Subjects treated are Electricity in all its Branches, Magnetism, Heat, Light, Photography, Microscopy, Optical Illusions, Mechanics, etc. A world of Valuable Information. A Source of Rational Amusement. A superb work for Young and Old.

Illustrated Circular and Table of Contents sent free.
740 PAGES. 680 ILLUSTRATIONS.
PRICE, by mail, postpaid, - - - $4.00.
MUNN & CO., Publishers,
Office of THE SCIENTIFIC AMERICAN,
361 Broadway, New York.



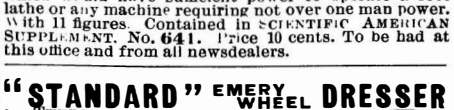
CUT THIS OUT AND SAVE TEN PER CENT ON YOUR ORDER BEFORE SEPT 1ST SEND FOR CIRCULAR TO H. C. STILWELL, DAYTON, O.

ELECTRO MOTOR, SIMPLE, HOW TO

make. By G. M. Hopkins.—Description of a small electro motor devised and constructed with a view to assisting amateurs to make a motor which might be driven with advantage by a current derived from a battery, and which would have sufficient power to operate a foot lathe or any machine requiring not over one man power. With 11 figures. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. **641**. Price 10 cents. To be had at this office and from all newsdealers.

"STANDARD" EMERY WHEEL DRESSER

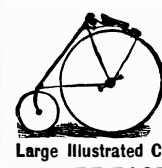
for Truing and Sharpening Emery Wheels.



Price complete with extra cutter, $2.00.
Single Cutters without handle, 40 cents each.

Cutters supplied to fit *any make* of handle. If you do not wish to buy complete tool, send 40c. with name of the make of handle you have, and we will send cutter to fit. Will last *three times* as long as any other make.
STANDARD TOOL CO., Cleveland, Ohio.
Our Twist Drills and Tools are sold by all dealers in Hardware and Supplies. ☞ *Send for Catalogue.*

ALANSON CARY MANUFACTURER OF FLAT STEEL SPRINGS OF EVERY DESCRIPTION
240 & 242 W. 29TH ST. NEW-YORK.



THE EAGLE
THE EASIEST RUNNING BICYCLE IN THE WORLD.
☞ Speed, Comfort and Safety.
AGENTS WANTED.
Large Illustrated Catalogue sent Free to any Address.
THE EAGLE BICYCLE MFG. CO.,
STAMFORD, CONN.

THE PHONOGRAPH.—A DETAILED

description of the new and improved form of the phonograph just brought out by Edison. With 8 engravings. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. **632**. Price 10 cents. To be had at this office and from all newsdealers.

The Scientific American

PUBLICATIONS FOR 1891.

The prices of the different publications in the United States, Canada, and Mexico are as follows:

RATES BY MAIL.

The Scientific American (weekly), one year	$3.00
The Scientific American Supplement (weekly), one year,	5.00
The Scientific American, Spanish Edition (monthly), one year,	3.00
The Scientific American Architects and Builders Edition (monthly), one year,	2.50

COMBINED RATES.

The Scientific American and Supplement,	$7.00
The Scientific American and Architects and Builders Edition,	5.00
The Scientific American, Supplement, and Architects and Builders Edition,	9.00

Proportionate Rates for Six Months.

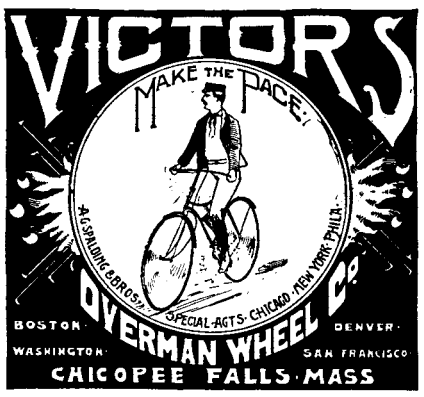
This includes postage, which we pay. Remit by postal or express money order, or draft to order of
MUNN & CO., 361 Broadway, New York.

© 1891 SCIENTIFIC AMERICAN, INC.

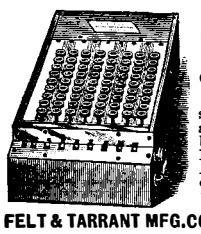
Advertisements.

Inside Page, each insertion - - 75 cents a line
Back Page, each insertion - - - - $1.00 a line

The above are charges per agate line—about eight words per line. This notice shows the width of the line, and is set in agate type. Engravings may head advertisements at the same rate per agate line, by measurement, as the letter press. Advertisements must be received at Publication Office as early as Thursday morning to appear in the following week's issue.



DEVELOPMENT OF AMERICAN Blast Furnaces. with special reference to large Yields.—By James Gayley. A description of some of the principal blast furnaces in the United States, showing the changes in design and practice by means of which extraordinarily large yields have been obtained in the last decade. With 8 figures. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. **776.** Price 10 cents. To be had at this office and from all newsdealers.



ADDITION, SUBTRACTION, MULTIPLICATION, DIVISION, INTEREST, EXCHANGE, PERCENTAGE, &c.

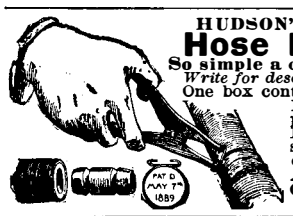
The **COMPTOMETER** solves rapidly and accurately all arithmetical problems. Operated by keys. Saves 60 per ct. of time. Entire relief from mental strain. Adapted to all commercial accounting and scientific computations. SEND FOR CIRCULAR.

FELT & TARRANT MFG.CO., 52-56 Illinois St., Chicago.

TO BUSINESS MEN

The value of the SCIENTIFIC AMERICAN as an advertising medium cannot be overestimated. Its circulation is many times greater than that of any similar journal now published. It goes into all the States and Territories, and is read in all the principal libraries and reading rooms of the world. A business man wants something more than to see his advertisement in a printed newspaper. He wants circulation. This he has when he advertises in the SCIENTIFIC AMERICAN. And do not let the advertising agent influence you to substitute some other paper for the SCIENTIFIC AMERICAN, when selecting a list of publications in which you decide it is for your interest to advertise. This is frequently done for the reason that the agent gets a larger commission from the papers having a small circulation than is allowed on the SCIENTIFIC AMERICAN.

For rates see top of first column of this page, or address **MUNN & CO., Publishers,**
361 Broadway, New York.

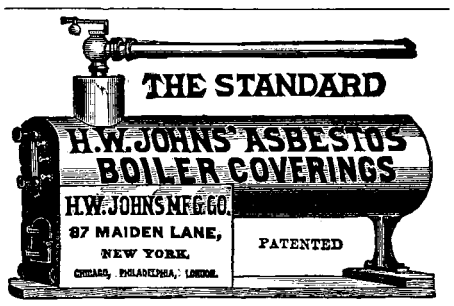


HUDSON'S GARDEN
Hose Mender,
So simple a child can use it.
Write for descriptive circular.
One box containing 6 Tubes, 20 Bands, 1 pair Pliers, post-paid, **$1.00.** Extra parts sold separately. All dealers keep them. **Agents wanted.** CHAS. E. HUDSON, Leominster, Mass.

MACHINE TOOLS
Engine Lathes, Planers, Shapers, Turret Lathes, etc. *Send for Catalogue.*
The Hendey Mach. Co., Torrington, Conn.

MALLEABLE AND FINE GRAY IRON ALSO STEEL CASTINGS FROM SPECIAL PATTERNS FINE TINNING, JAPANNING AND FINISHING
THOMAS DEVLIN & CO. LEHIGH AVE. & AMERICAN ST. PHILA.

WORKING LOCOMOTIVES WITH Petroleum Fuel.—By Thomas Urquhart. An interesting account of the recent results of the author's experience in the use of petroleum refuse as fuel on an unprecedented scale upon the Grazi & Tsaritsin Railway, Southeast Russia. With 52 illustrations. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, Nos. **769** and **770.** Price ten cents each. To be had at this office and from all newsdealers.



THE AMERICAN BELL TELEPHONE CO.

95 MILK ST., BOSTON, MASS.

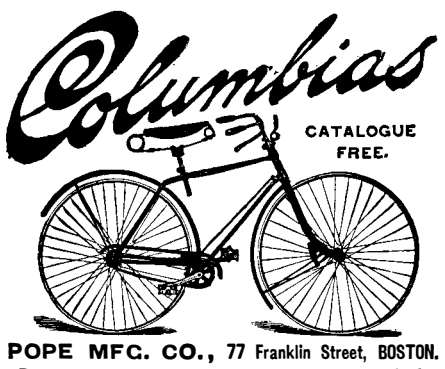
This Company owns the Letters Patent granted to Alexander Graham Bell, March 7th, 1876, No. 174,465, and January 30th, 1877, No. 186,787.

The transmission of Speech by all known forms of Electric Speaking Telephones infringes the right secured to this Company by the above patents, and renders each individual user of telephones not furnished by it or its licensees responsible for such unlawful use, and all the consequences thereof, and liable to suit therefor.

Take A Kodak With you.

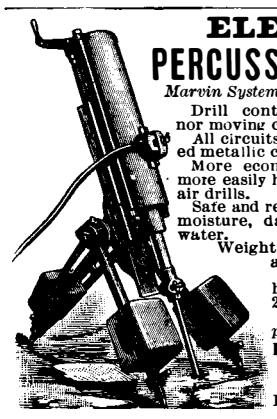
Send to The Eastman Company, Rochester, N. Y., for a copy of "Through Europe with a Kodak," (illustrated,) free by mail.

It will perpetuate the pleasure of your summer trip.



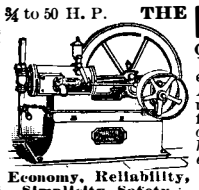
POPE MFG. CO., 77 Franklin Street, BOSTON.
Branch Houses: 12 Warren St., NEW YORK, 291 Wabash Ave., CHICAGO. Factory, HARTFORD, CONN.

ASSAYERS & CHEMISTS MARINER & HOSKINS, 81 S. Clark St., Chicago. See Advertisement in this paper June 13, 1891.



ELECTRIC PERCUSSION DRILLS
Marvin System of Percussion Tools.

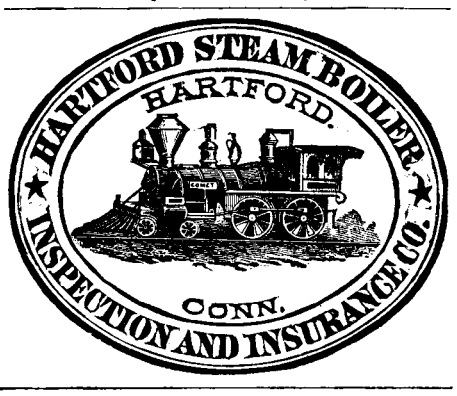
Drill contains no commutator nor moving contacts.
All circuits are protected in closed metallic cases.
More economical, simpler, and more easily handled than steam or air drills.
Safe and reliable. Not affected by moisture, dampness, or dripping water.
Weight of drill, with tripod, about 400 pounds.
Speed of drilling in hard granite, 2 in. hole, 2 inches per minute.
Send for descriptive pamphlet and prices.
Edison General Electric Co.
Edison Building, Broad St., New York.



¾ to 50 H. P. **THE Motor of 19th Century**
Can be used *Any Place*, to do *Any Work*, and by *Any One*. No Boiler! No Fire! No Steam! No Ashes! No Gauges! No Engineer! A perfectly safe Motor for all places and purposes. *Cost of operation about one cent an hour to each indicated horse power.* For circulars, etc., address
Economy, Reliability, Simplicity, Safety. **CHARTER GAS ENGINE CO. P. O. Box 148, Sterling, Ill.**

SAWS Wanted 50,000 Sawyers and Lumbermen to send us their full address for a copy of Emerson's Book of **SAWS**, new 1890 edition. We are first to introduce NATURAL GAS for heating and tempering **Saws** with wonderful effect upon improving their quality and toughness, enabling us to reduce prices. Address **EMERSON, SMITH & CO. (Limited), Beaver Falls, Pa.** **SAWS**

THE COPYING PAD—HOW TO MAKE and how to use; with an engraving. Practical directions how to prepare the gelatine pad, and also the aniline ink by which the copies are made, how to apply the written letter to the pad, how to take off copies of the letter. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. **438.** Price 10 cents. For sale at this office and by all newsdealers in all parts of the country.



SIEMEN'S + CABLES.

SUBMARINE, + + + + + TELEGRAPH,
UNDERGROUND, + + + TELEPHONE,
INTERIOR, + ELECTRIC LIGHT.

Manufactured under authority of
SIEMENS & HALSKE by **THE EDISON GENERAL ELECTRIC CO.**
at their **SCHENECTADY WORKS.**
Estimates furnished on application.

Address,
Wire Department, Edison General Electric Company,
EDISON BUILDING, Broad St., NEW YORK.

Steam! Steam!

Quality Higher, Price Lower.
For Strictly Cash, Complete Fixtures except Stack.
2-Horse Eureka Boiler and Engine, - $145
4- " " " " " - 225
Other sizes at low prices. Before you buy get our prices.
B. W. PAYNE & SONS,
Drawer 56. **ELMIRA, N. Y.**

PATENT JACKET KETTLES
Plain or Porcelain Lined.
Tested to 100 lb. pressure. Send for Lists.
BARROWS-SAVERY CO.,
S. Front & Reed Streets, Philadelphia, Pa.

ATMOSPHERIC DUST.—BY WILLIAM Marcet, F.R.S. An address delivered to the Royal Meteorological Society. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. **755.** Price 10 cents. To be had at this office and from all newsdealers.

PATENT STEAM-PIPE CASING
—FOR—
Underground Steam Pipes

Two staves removed to show lining between inside and outside staves.

A. WYCKOFF & SON,
116 East Chemung Place,
ELMIRA, N. Y.

Scientific Book Catalogue

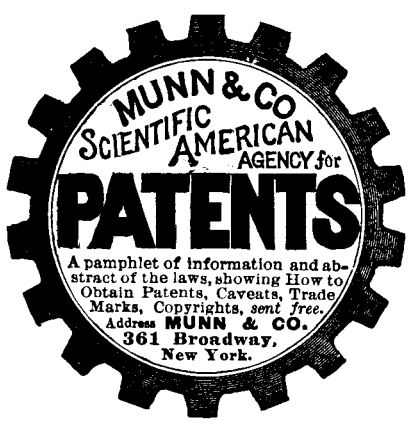
RECENTLY PUBLISHED.

Our new catalogue containing over 100 pages, including works on more than fifty different subjects. Will be mailed free to any address on application.
MUNN & CO., Publishers Scientific American,
361 Broadway, New York.

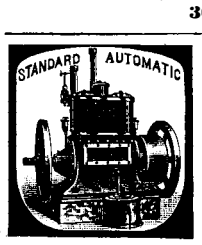
LEARN WATCHMAKING, Engraving, and kindred branches. *Send for Prospectus.* CHICAGO WATCHMAKERS' INSTITUTE, 22 Van Buren Street, CHICAGO.

GEAR CUTTING

Leland, Faulconer & Norton Co., Detroit, Mich


MUNN & CO
SCIENTIFIC AMERICAN
AGENCY for
PATENTS
A pamphlet of information and abstract of the laws, showing How to Obtain Patents, Caveats, Trade Marks, Copyrights, *sent free.*
Address MUNN & CO.
361 Broadway,
New York.

SMALL ELECTRIC MOTOR FOR AMateurs.—By C. D. Parkhurst. Description in detail of a small and easily made motor powerful enough to drive a ten or twelve inch brass fan and to give a good breeze. With 15 figures drawn to a scale. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. **767.** Price 10 cents. To be had at this office and from all newsdealers.



WESTINGHOUSE ENGINES

OVER 6000 RUNNING DAILY IN EVERY PART OF THE WORLD.

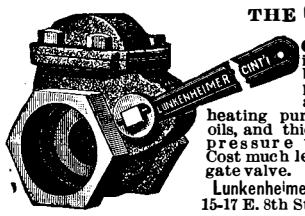
STANDARD AUTOMATIC	COMPOUND AUTOMATIC	JUNIOR AUTOMATIC
HUNDREDS IN CONTINUOUS USE OVER 9 YEARS. 5 TO 250 H.P.	UNEQUALED FOR FUEL DUTY AND SIMPLICITY. 35 TO 300 H.P.	CHEAPER THAN A COMMON SLIDE VALVE. 5 TO 75 H.P.

THE WESTINGHOUSE MACHINE COMPANY, PITTSBURGH, PA. U.S. OF A.

THE GRAVES ELEVATORS.

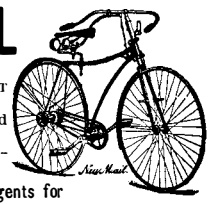
PASSENGER & FREIGHT. L. S. GRAVES & SON ROCHESTER N.Y. NEW YORK. BOSTON. ST. LOUIS. DETROIT.

ICE HOUSE AND REFRIGERATOR. Directions and Dimensions for construction, with one illustration of cold house for preserving fruit from season to season. The air is kept dry and pure throughout the year at a temperature of from 34° to 36°. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. **116.** Price 10 cents. To be had at this office and of all newsdealers.



THE "HANDY"
GATE VALVE is the simplest and best valve for low pressure steam and hot water heating purposes for water, oils, and thick fluids for any pressure under 75 pounds. Cost much less than any other gate valve.
Lunkenheimer Brass Mfg. Co.
15-17 E. 8th St., Cincinnati, O.

NEW MAIL



New Grade, $100.
CUSHION TIRES and TANGENT SPOKES.
Handsomest and Best Diamond Safety.
Send for Catalogue and Second-Hand List.

Also Sole New England Agents for

LITTLE GIANT
PRICE, $35.00.
Only Boy's Safety with a Spring Fork, preventing injury to young riders from jar and vibration.

WM. READ & SONS, 107 Washington St. BOSTON, MASS.

THE

SCIENTIFIC AMERICAN

ESTABLISHED 1846.

The Most Popular Scientific Paper in the World

Only $3.00 a Year, Including Postage. Weekly—52 Numbers a Year.

This widely circulated and splendidly illustrated paper is published weekly. Every number contains sixteen pages of useful information and a large number of original engravings of new inventions and discoveries, representing Engineering Works, Steam Machinery, New Inventions, Novelties in Mechanics, Manufactures, Chemistry, Electricity, Telegraphy, Photography, Architecture, Agriculture, Horticulture, Natural History, etc. Complete list of patents each week.

Terms of Subscription.—One copy of the SCIENTIFIC AMERICAN will be sent for *one year*—52 numbers—postage prepaid, to any subscriber in the United States, Canada, or Mexico, on receipt of **three dollars** by the publishers; six months, $1.50; three months, $1.00.

Clubs.—Special rates for several names, and to Post Masters. Write for particulars.

The safest way to remit is by Postal Order, Draft, or Express Money Order. Money carefully placed inside of envelopes, securely sealed, and correctly addressed, seldom goes astray, but is at the sender's risk. Address all letters and make all orders, drafts, etc., payable to
MUNN & CO., 361 Broadway, New York.

THE

Scientific American Supplement

This is a separate and distinct publication from THE SCIENTIFIC AMERICAN, but is uniform therewith in size, every number containing sixteen large pages full of engravings, many of which are taken from foreign papers, and accompanied with translated descriptions. THE SCIENTIFIC AMERICAN SUPPLEMENT is published weekly, and includes a very wide range of contents. It presents the most recent papers by eminent writers in all the principal departments of Science and the Useful Arts, embracing Biology, Geology, Mineralogy, Natural History, Geography, Archæology, Astronomy, Chemistry, Electricity, Light, Heat, Mechanical Engineering, Steam and Railway Engineering, Mining, Ship Building, Marine Engineering, Photography, Technology, Manufacturing Industries, Sanitary Engineering, Agriculture, Horticulture, Domestic Economy, Biography, Medicine, etc. A vast amount of fresh and valuable information obtainable in no other publication.

The most important Engineering Works, Mechanisms, and Manufactures at home and abroad are illustrated and described in the SUPPLEMENT.

Price for the SUPPLEMENT for the United States and Canada, $5.00 a year; or one copy of the SCIENTIFIC AMERICAN and one copy of the SUPPLEMENT, both mailed for one year for $7.00. Single copies, 10 cents. Address and remit by postal order, express money order, or check,
MUNN & CO., 361 Broadway, New York,
Publishers SCIENTIFIC AMERICAN.

Building Edition.

THE SCIENTIFIC AMERICAN ARCHITECTS' AND BUILDERS' EDITION is issued monthly. $2.50 a year. Single copies, 25 cents. Forty large quarto pages, equal to about two hundred ordinary book pages; forming a large and splendid Magazine of Architecture, richly adorned with *elegant plates in colors*, and with other fine engravings; illustrating the most interesting examples of modern architectural construction and allied subjects.

A special feature is the presentation in each number of a variety of the latest and best plans for private residences, city and country, including those of very moderate cost as well as the more expensive. Drawings in perspective and in color are given, together with full Plans, Specifications, Sheets of Details, Estimates, etc.

The elegance and cheapness of this magnificent work have won for it the **Largest Circulation** of any Architectural publication in the world. Sold by all newsdealers. $2.50 a year. Remit to
MUNN & CO., Publishers,
361 Broadway, New York.

PRINTING INKS

The SCIENTIFIC AMERICAN is printed with CHAS. ENEU JOHNSON & CO.'S INK, Tenth and Lombard Sts., Philadelphia, and 47 Rose St., opp. Duane, New York

© 1891 SCIENTIFIC AMERICAN, INC.